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SEPTEMBER 1974

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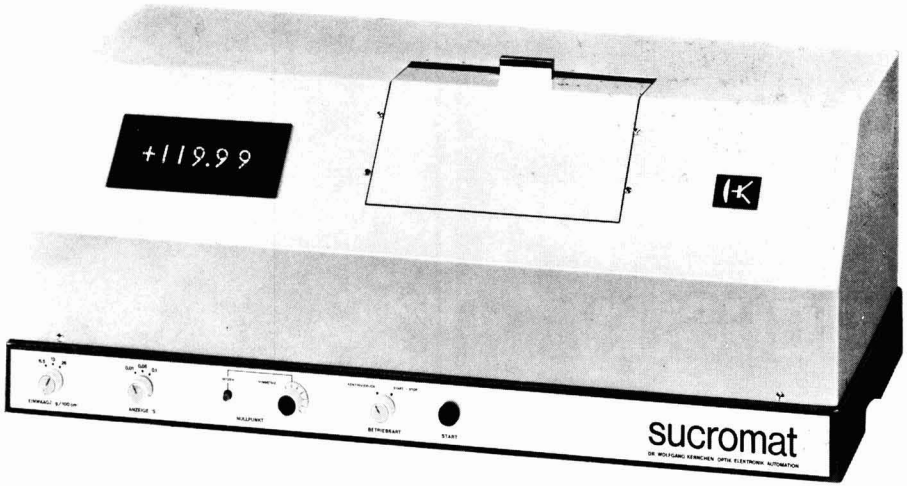

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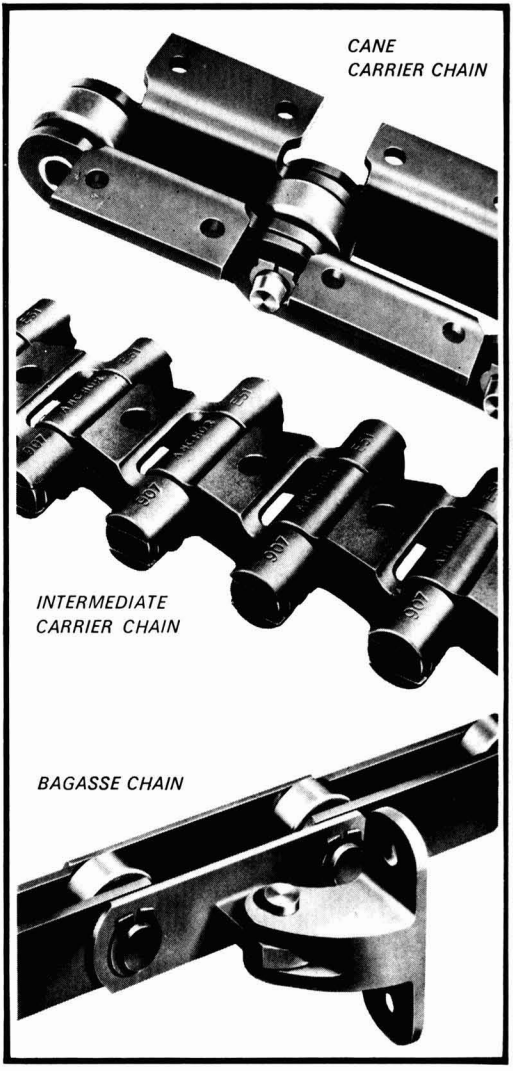

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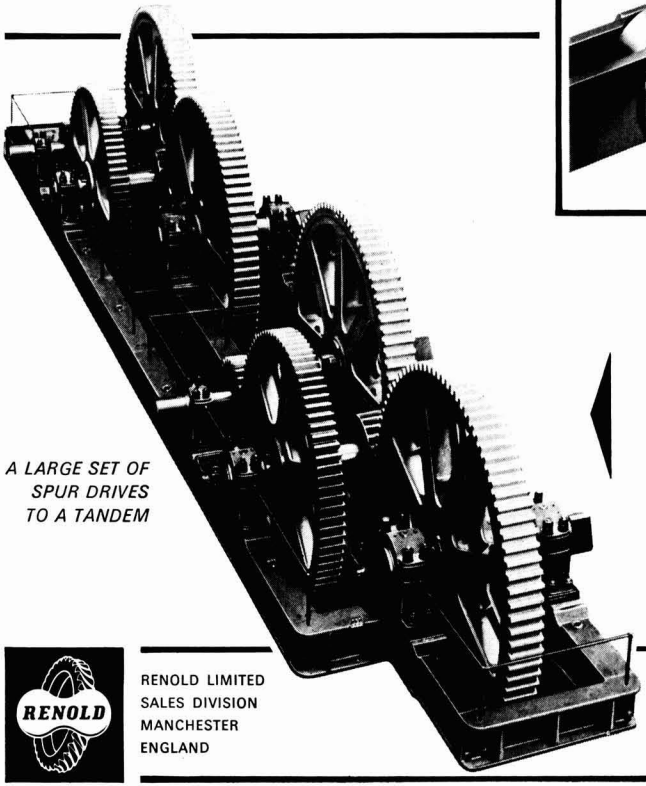

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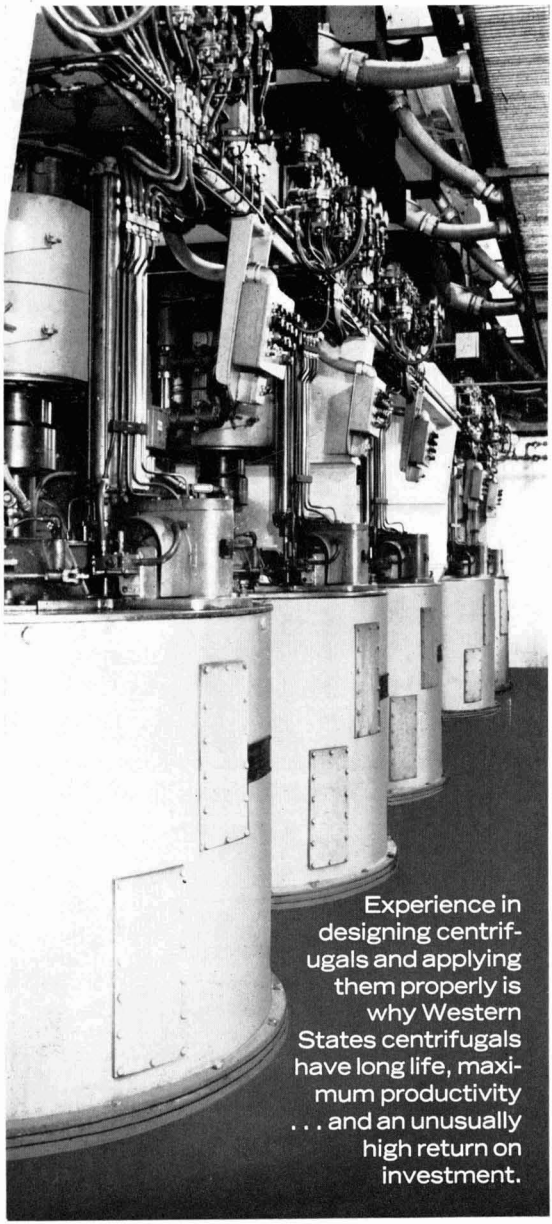

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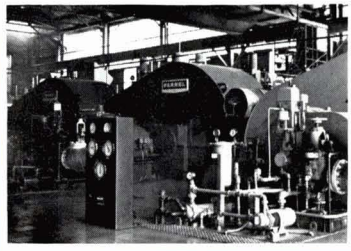

Aerial view of Gulf & Western's Okeelanta sugar factory and installation picture of Farrel drives in operation at the Central Romana factory.

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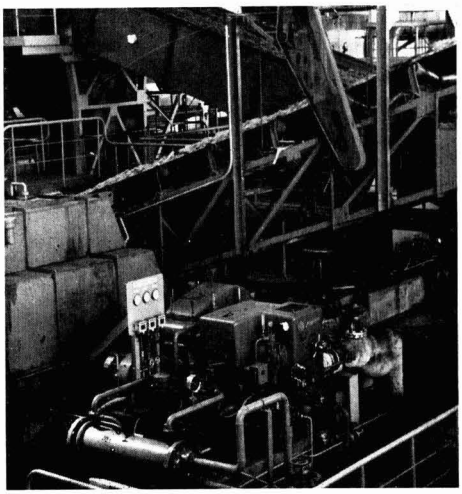

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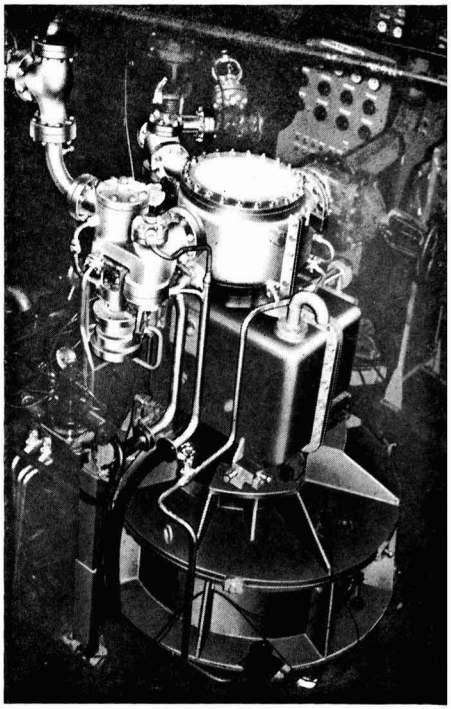

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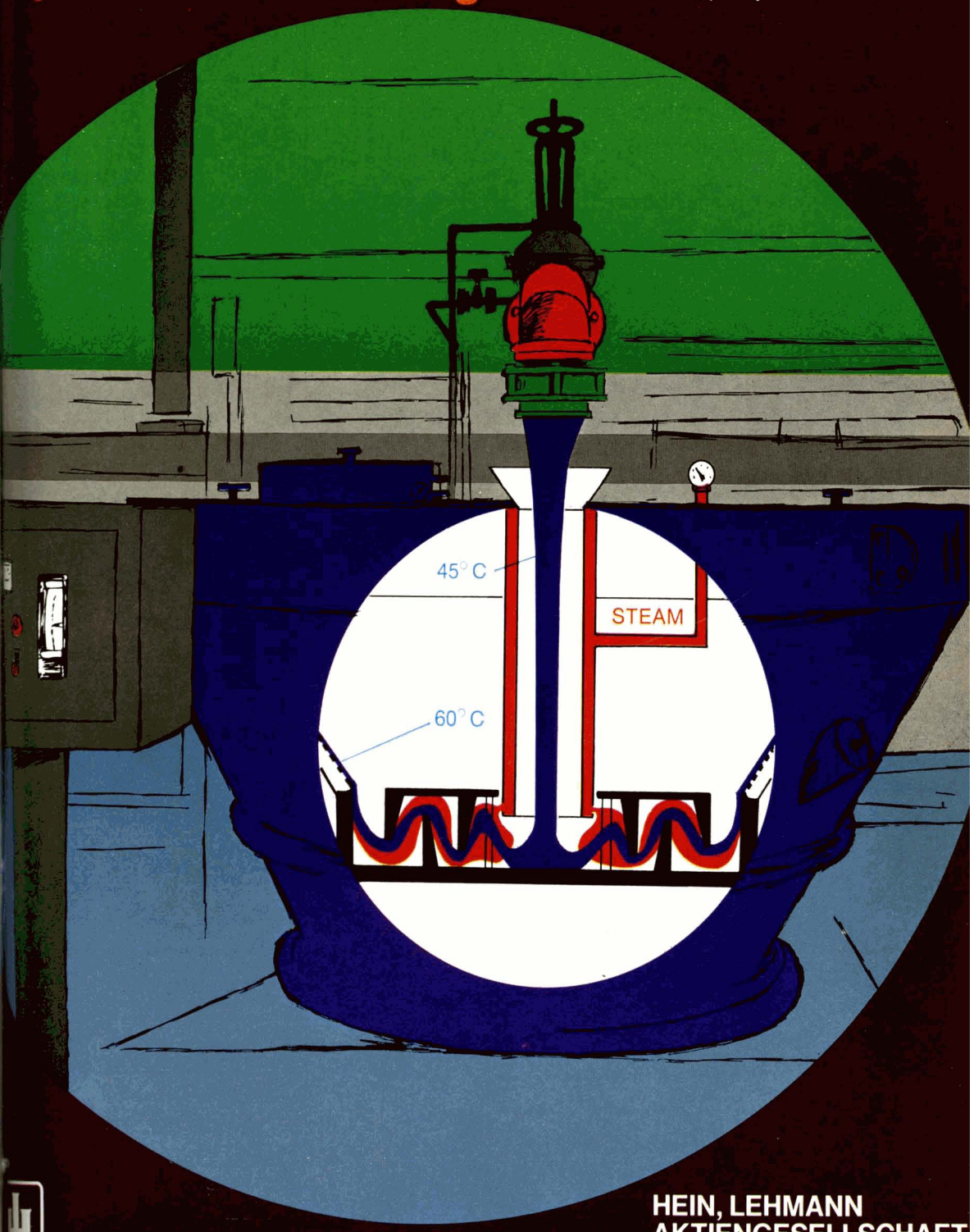

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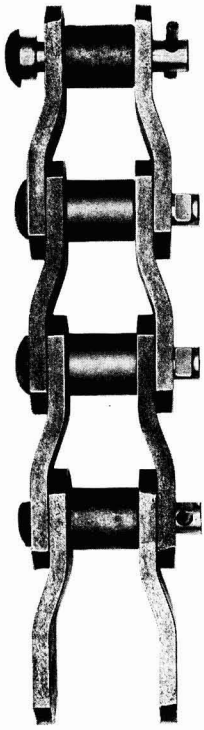

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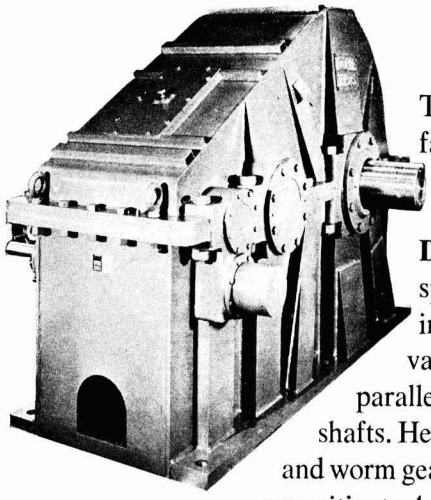

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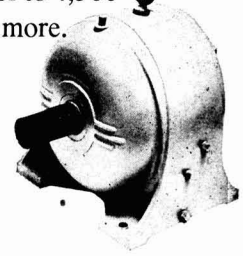

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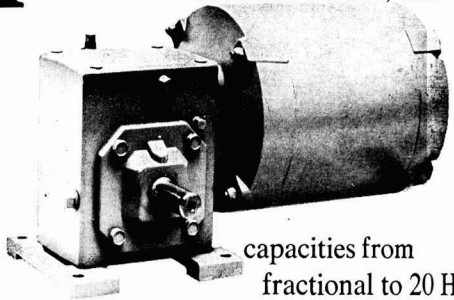

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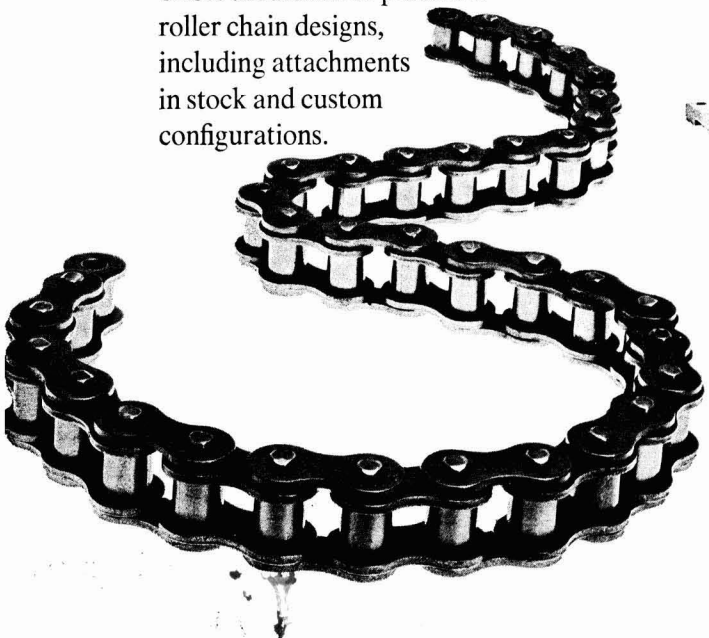

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International Sugar Journal

September 1974

Contents

SOMMAIRES : ZUSAMMENFASSUNGEN : SUMARIOS

Commission Internationale pour l'Uniformisation des Méthodes Analytiques, 16me Session 1974. *p.* 259–260

La 16me Session d'ICUMSA fut tenu en Turquie du 1r au 7 juin. On donne des informations sur le programme, y inclus les réunions officielles et les visites aux endroits d'intérêt. On fournira des détails sur les sujets traités, les rapporteurs et les recommendations acceptées à l'avenir dans ce journal.

* * *

Effets d'activité thermophilique en diffusion de betteraves. Partie I. J. F. T. OLDFIELD, J. V. DUTTON et M. SHORE. *p.* 260–263

On discute des effets de bactéries thermophiliques sur les pertes en diffusion des betteraves et sur les moyens pour déterminer ces pertes. On considère comme l'approximation la meilleure pour la perte en sucre celle où on la considère comme égale à deux fois la quantité d'acide lactique formé. On examine aussi l'effet sur la stabilité du jus de la production d'acide.

* * *

Résistance des variétés de canne à sucre à la chenille *Tryporyza nivella* (Fabricius). R. A. AGARWAL, D. K. BUTANI et C. B. TIWARI. *p.* 263–265

On a fait des expériences avec 27 variétés de canne pour déterminer leur résistance envers la chenille *T. nivella*. Ces essais furent suivis d'autres tests avec 8 variétés qui étaient sélectionnées parmis la liste originale. On rapporte leur degré de résistance.

* * *

Pertes en sucre dans les lavoirs à betteraves. Partie II. R. DE VLETTER et W. VAN GILS. *p.* 266–269

Le deuxième volet de cet article se rapporte à des résultats obtenus avec des lavoirs à tambour et à jets d'eau. On compare ceux-ci avec les lavoirs à bras mouvants décrits dans la première partie. Les meilleurs résultats furent obtenus avec les différents types de lavoirs à jet d'eau. Il est cependant souligné que le jugement final au sujet de l'efficience sera basé sur la comparaison de l'efficience totale et du coût total des installations complètes, y compris les épierreurs et les désherbeurs, ainsi que les systèmes de recirculation d'eau.

16. Sitzung 1974 der Internationalen Kommission für einheitliche Methoden der Zuckeruntersuchung (ICUMSA). *S.* 259–260

Die 16. Sitzung der ICUMSA fand vom 1. bis zum 7. Juni in der Türkei statt. Im vorliegenden Bericht wird über das Tagungsprogramm informiert, und zwar sowohl über die Arbeitssitzungen als auch über den Besuch von interessanten Plätzen. Einzelheiten über die Referate, die Referenten und die angenommenen Empfehlungen werden später in dieser Zeitschrift erscheinen.

* * *

Einflüsse der Aktivität von Thermophilen während der Saftgewinnung auf die Verarbeitung der Zuckerrüben. Teil I. J. F. T. OLDFIELD, J. V. DUTTON und M. SHORE. *S.* 260–263

Die Verfasser diskutieren die Einflüsse der thermophilen Bakterien auf die Verluste in der Saftgewinnung sowie Methoden zur Bestimmung dieser Verluste. Als bester Näherungswert für die Zuckerverluste wird der Wert angesehen, den man erhält, wenn man die Menge der gebildeten Milchsäure verdoppelt. Weiter wird der Einfluss der Säurebildung auf die Saftstabilität untersucht.

* * *

Resistenz von Zuckerrohr-Zuchtrichtungen gegenüber dem Stengelspitzenbohrer *Tryporyza nivella* (Fabricius). R. A. AGARWAL, D. K. BUTANI und C. B. TIWARI. *S.* 263–265

Im Anschluss an Untersuchungen, die an 27 Zuckerrohr-Zuchtrichtungen zur Bestimmung ihrer Resistenz gegenüber dem Stengelspitzenbohrer durchgefürt werden, haben die Verfasser ihre Versuche mit 8 aus der ursprünglichen Zahl ausgewählten Zuchtrichtungen fortgesetzt. Für diese wird das Resistenzvermögen angegeben.

* * *

Zuckerverluste bei der Rübenwäsche. Teil II. R. DE VLETTER und W. VAN GILS. *S.* 266–269

Im zweiten Teil dieser Arbeit sind die Versuchsergebnisse besprochen, die mit Trommel- und mit Düsenwäschen erhalten wurden. Diese beiden Wäschetypen werden mit der in Teil I beschriebenen Knüppelwäsche verglichen. Die besten Resultate zeigten die verschiedenen Arten von Düsenwäschen, aber es wird nachdrücklich darauf hingewiesen, dass zu einer endgültigen Beurteilung der Leistungsfähigkeit ein Vergleich des Gesamtwirkungsgrades und der Kosten der vollständigen Einrichtung einschliesslich Stein- und Krautabscheidern sowie der Wasserrücknahme erforderlich ist.

16a Sesión de la International Commission for Uniform Methods of Sugar Analysis, 1974. *Pág.* 259–260

La 16a Sesión de ICUMSA se celebró el 1–7 junio en Turquía, y en este artículo se presenta información acerca del programma, incluyendo los reuniones oficiales y visitas a lugares de interés. Detalles do los Sujetos, sus Referees (Arbitros) y las recomendaciones aceptado parecerán en una próxima edición de esta revista.

* * *

Efectos de actividad termofílica en difusión sobre tratamiento de remolacha de azúcar. Parte I. J. F. T. OLDFIELD, J. V. DUTTON y M. SHORE. *Pág.* 260–263

Se discuten los efectos de bacterias termofílicas sobre pérdidas en difusión de remolacha y métodos para medir estas pérdidas. Se considera que la mejor aproximación de la pérdida de azúcar es dos veces la cantidad de ácido láctico que se forma. Se examina también el efecto de producción de ácido sobre el estabilidad de jugo.

* * *

Resistencia de variedades de caña de azúcar contra el barrenador de la punta, *Tryporyza nivella* (Fabricius). R. A. AGARWAL, D. K. BUTANI y C. B. TIWARI. *Pág.* 263–265

Después de experimentos con 27 variedades de caña para determinar su resistencia al barrenador de la punta se hicieron otros ensayos con 8 variedades escogido del número original. Se indican los grados de resistencia.

* * *

Pérdidas de azúcar en lavado de remolacha. Parte II. R. DE VLETTER y W. VAN GILS. *Pág.* 266–269

En la segunda parte de este artículo se conciernen resultas de ensayos obtenido con lavadores de remolacha de la forma de tambores y del tipo con rociadores. Se comparen éstos y los lavadores con brazos giratorios que se han describido en Parte I. Las menores resultas se obtienen con los varios tipos de lavador con rociadores pero los autores sub.ayan que juicio final del cumplimiento contara con comparación de eficiencias totales y costes de instalaciones integrados que incluyen separadores de piedras y malas hierbas y las sistemas de recirculación de agua.

THE

INTERNATIONAL SUGAR JOURNAL

VOL. LXXVI SEPTEMBER 1974 No. 909

Notes & Comments

UK beet sugar production and prices

Mr. ROB TAZELAAR, a member of the Sugar Department of the EEC Commission, stated at the end of June that the sugar beet area in the UK could only be increased by an insignificant amount during the next three years since the production capacity of the British Sugar Corporation would not allow for a big increase. There was a rapid refutation of this view from the Chief Executive of the BSC who stated that capacity was already well in excess of the EEC basic quota of 900,000 metric tons and a £35 million expansion and reconstruction programme was in progress which would raise capacity to 1·1 million tons. Mr. SINCLAIR continued: "We are satisfied that, subject to a satisfactory price structure for beet and sugar, the necessary additional acreage of beet could be made available and the Corporation's reconstruction programme could be further developed and expanded in order to increase total sugar production to 1·25 million tons a year".

A representative of the UK National Farmers' Union has stated, however, that the 1974 crop in Britain will be particularly disappointing and suggested that growers were losing confidence in beet as an economic crop at current prices. Pointing out that an expansion in the tonnage of domestically produced sugar would bring advantages both to the consumer and the economy, he stated that this could only be achieved if the Government gave a firm assurance of an increased return for the crop in 1975.

The Corporation has been seeking permission to raise the price it pays to growers to £8·84 per metric ton for the 1974 crop, which would bring the BSC into line with other EEC beet processors and afford an encouragement to farmers to grow beet in the future so as to permit expansion of production and avoidance of tight supply positions. The Government announced, however, on the 2nd August, that the UK will adopt the full EEC intervention price for sugar from the 1st January 1975 (£118.39 per ton against the 1974 price of £102.57), which will permit the payment of the full EEC minimum price for beet. It has not been announced whether this price will be paid for beets sliced before the end of 1974, although Mr. SINCLAIR has indicated that the price for 1974 beets will be higher than the 1973 price of £7.65 per ton.

He added that there was another aspect to the crisis of confidence that was affecting the industry: "Recent proposals from the EEC Commission would in effect limit the UK beet industry to its present size while boosting production in the original six member countries. This is clearly discriminatory and we have asked the Minister of Agriculture to fight these proposals". The case for expanding the British beet sugar industry was overwhelming. "Both on price and reliability of supply more home-grown sugar is the answer for the housewife and the country. Our sugar is the cheapest in the world at £111 a ton while world prices are over £270 a ton, and we could be supplying half of UK's sugar within a few years".

* * *

USSR sugar statistics

The International Sugar Organization has recently published[1] calendar year statistics for the Soviet Union covering 1973 and two previous years, as well as monthly details for the first three months of 1974. It is interesting to note that, this year, imports up to March are solely from Cuba and amount to 429,300 metric tons, raw value, whereas in 1973 imports totalled 1,050,502 tons of which Cuba supplied 476,677 tons. This reflects the improvement in Soviet domestic beet sugar production which in the previous two years had been sufficiently low that substantial imports had been required from the world market.

So far the USSR has not returned to being an exporter of white sugar in any great amount, however, since only 23,242 tons were sent to three destinations. Total exports were only 64,187 tons in 1972 and 46,336 tons in 1973, whereas in 1971 they reached 1,401,548 tons and were sent to over thirty destinations. This may be the result of insufficient beet sugar production to provide a surplus over consumption or perhaps indicates the rebuilding of stocks. It is difficult to judge while the USSR refrains from publishing records of its campaign results and gives only calendar year figures which include parts of two seasons.

[1] *I.S.O. Stat. Bull.*, 1974, **33**, (6), 107–109.

World raw sugar price

The market had been firm for several weeks up to the middle of July but suddenly there was a spurt of buying interest, perhaps given impetus by a report from the US Dept. of Agriculture indicating an unsatisfactory beet crop in the USSR this year. Prices started upwards and from £250 on the 18th July the London Terminal Daily Price had reached £280 by the 25th, reflecting sales which had taken place. After advancing to £284 on the 29th July, the price fell to £277 for three days but then resumed its upward trend and reached £300 per ton on the 7th August, at which date the ISA price was 29·17 cents/lb.

* * *

Western Europe beet area and crop prospects

Estimates of Western European beet areas released by the International Association for Sugar Statistics in nearly all cases show close agreement with the figures provided by F. O. Licht K.G. One major exception is Spain, where the area has been put by the IASS at 140,000 ha, or 40,000 ha below Licht's figure and 51,000 ha below the area for the 1973/74 crop. It is pointed out by C. Czarnikow Ltd.[1] that despite steps taken by Spain to ensure substantial imports of sugar for this year, whereby a total of some 550,000 tons of sugar, tel quel, should cover normal consumption requirements, this still means that good yields from domestic beet are still necessary, particularly in view of the reduced area. Doubt is also cast by Czarnikow on the figure of 200,000 ha given by Licht as their assessment for Italy, since latest figures have fallen short of the targets in some regions. It is also felt that the UK figure is unlikely to be reached—although an increased area of 8000 ha was authorized, unfavourable weather conditions have apparently led to this area since being ploughed up.

Despite a marked change in weather conditions in the latter half of June, with heavy and, in many cases, prolonged periods of rain making up for previous drought conditions, it is felt by some observers that the change will have come too late to make up for poor emergence in many areas of Western Europe, although there is no doubt that the disastrous results forecast earlier will have been avoided.

* * *

Thailand export tax on sugar

It is reported[2] that the Thailand Government has imposed an export tax on sugar which will vary in line with the f.o.b. price received. On prices up to 4000 baht per metric tons (48·6 baht = £1) exports will be free of tax, but from 4000 to 6000 baht a 25% tax will be imposed on that portion exceeding 4000 baht, while from 6000 to 7500 baht the levy will be 50% and above 7500 baht it will be 75%. It is anticipated that Thailand will export 150,000 tons of sugar during the remainder of 1974 and it has been stated that levies received will be put into a sugar price stabilization fund to help cane farmers. Although output in Thailand has expanded considerably in recent years, the tax is bound to be looked on with disfavour by producers and it remains to be seen whether further growth will now be impeded.

* * *

UK sugar shortage

A new scale of prices for sugar within the EEC came into effect on 1st July and in the UK the intervention price for white sugar in bulk ex-factory rose by £9.67 per long ton to £102.57. Reflecting this increase, the British Sugar Corporation increased their home trade price by £9.60 to £111.50 per ton. With a failure by certain Commonwealth countries to meet their obligations under the Commonwealth Sugar Agreement, white sugar has been imported from the Continent and the refiners have had to seek supplies of raw sugar on the world market and the higher cost has resulted in Tate & Lyle increasing their home trade price to £118.00 per ton and the Manbré Group to £121.00 per ton.

An actual shortage of supplies of raw sugar has occurred but in recent weeks there has been a much more apparent dearth of sugar in UK food shops even in areas normally fully supplied by the BSC whose deliveries are little less than normal. In a written Parliamentary reply to a question on the matter, the Minister of Agriculture, Fisheries and Food said: "I would emphasize that, despite a shortfall in normal deliveries of raw sugar from the Caribbean, total supplies to the country as a whole over the year will be maintained at the normal level, since it has proved possible to make good the West Indian shortfall by buying from other sources, namely, the Continent and world market. However, this interruption in shipments has meant that some shops in Scotland, and in other areas, where consumption is seasonally high, have had their supplies reduced. I am taking steps to make additional sugar available to overcome these temporary difficulties and I am in close and constant touch with representatives of the refining companies and the distributive trade to see that supplies are directed flexibly to overcome any temporary local shortages. In all these measures I shall be paying particular attention to the needs of Scotland, given its existing dependence on supplies from the refineries in Greenock. In the present situation, customers will help themselves and others by buying only what is sufficient for their normal needs".

This is little comfort for the customer who has for some weeks been unable to buy *any* sugar, and since it is known that the refiners and the BSC have applied for permission to raise retail prices it is perhaps less cynical than realistic to suppose that, as soon as this is granted, increased supplies will become available from wholesalers' stores.

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[1] *Sugar Review*, 1974, (1185), 109.
[2] C. Czarnikow Ltd., *Sugar Review*, 1974, (1184), 105.

International Commission for Uniform Methods of Sugar Analysis

16th Session, 1974

DELEGATES from 27 countries assembled in Ankara, Turkey, for the 16th Session of ICUMSA, making it the largest gathering in the history of the Commission. The Turkish Sugar Factories Corporation had invited ICUMSA to hold its 1974 Session in their country and the first function was a welcoming cocktail party at the Grand Hotel (or Büyük Ankara Oteli) given by the General Director for the Corporation, Mr. ZEKI OZYAR and Mrs. OZYAR, on the 2nd June.

The Session proper began the next morning when delegates were addressed by the Director of the Turkish Sugar Institute, Mr. OSMAN BÖZÖK, Chairman of the Turkish National Committee of ICUMSA. Mr. BÖZÖK welcomed the visitors to Turkey and outlined the structure of his country's sugar industry before introducing the President of the Middle East Technical University who also addressed the Session. The President of the Commission, Dr. A. CARRUTHERS, then replied on behalf of the delegates and thanked their Turkish hosts for the kind welcome given.

In the afternoon, the first working meeting began with the Report of the President on Subject 1, with discussion and movement for acceptance or modification of the recommendations, and a similar pattern was used for the remainder of the Subjects Reports during the remainder of the Session.

In the evening, delegates were taken for a visit to the Sugar Institute, machinery workshops and sugar factory at Etimesgut before attending a garden party in the grounds of the Institute, where they were entertained by a troupe of university students who gave a polished display of folk dancing and music from various parts of Turkey. The following day was given to working meetings for discussion of Referee's reports, while in the evening delegates attended a dinner given by the Mayor of Ankara and Mrs. DALOKAY at the Ankara Palace Hotel, with a cabaret performance by a dancer and a number of delegates.

On the 5th June, the morning was taken up by working meetings while in the afternoon delegates were taken to the Hittite Museum in Ankara where displays span thousands of years from primitive wall paintings to Roman remains. A visit was also made to the Atatürk Mausoleum which is itself a memorial and museum to the man who brought Turkey into the modern world. Subsequently delegates were taken to the Middle East Technical University where they were able to inspect the Chemical Engineering Department's unit process laboratory as well as the museum of the Architecture School; in the latter were assembled archeological remains discovered on the campus of the University, dating from 3000 B.C. Tea was then provided by the President of the University before delegates returned to their hotels.

The following day was again taken up completely with working meetings while in the evening, delegates attended a performance of concert and ballet at the Opera House which featured a considerable number of artistes and music from both European and Turkish composers. On the last day of the Session, working meetings took up most of the day but after an afternoon meeting of the Committee, the final plenary meeting took place. Reporting on the Executive Committee meeting, the President mentioned that Dr. CARPENTER of the USA had proposed establishment of guidelines for the development of analytical procedures from being under study to tentatively adopted as official methods, and a new subject was proposed on method establishment.

It was announced that West Germany now has a national committee again, while committees have also been formed by Brazil and the Philippines. A proposal that the 4-yearly Session interval be reduced had not been accepted although it was agreed that beneficial results would come from collaboration and meetings between different national committees.

With the DE WHALLEY book of ICUMSA methods of analysis now out of print and also out of date, a new edition is to be prepared, with Prof. F. SCHNEIDER as Editor-in-Chief. Funds were sufficient to cover the cost of this book and no increase in affiliation subscriptions was called for in the next four years until the 17th Session for which an invitation had been offered by the Canadian National Committee to take place in Montreal.

Dr. J. HENRY, President of the Nominations Committee, presented his report and Dr. CARRUTHERS was called upon to serve a further term as President. He accepted this nomination which was met with acclamation. Srta. D. M. MARTÍNEZ of Cuba, Prof. G. MANTOVANI of Italy and Mr. P. DEVILLERS of France were proposed as Vice-Presidents for 1974/78, replacing Messrs. PUCHERNA, GUPTA, STACHENKO and SAUNIER. The fourth vacancy for Vice-President may be nominated and decided by postal ballot.

The new Nominations Committee is to comprise Dr. R. PIECK, Dr. F. CARPENTER and Mr. R. DE VLETTER, while the new Credentials Committee will include Mr. J. HUDSON and Mr. M. FLAVIELL. The Publications Committee for 1978 is to include Mr. DE VLETTER, Mr. D. J. HIBBERT, General Secretary of ICUMSA, and Mr. R. I. SAVAGE. Mr. HIBBERT and the Treasurer, Mr. G. WILSON, are to continue in their offices. All the nominations were accepted and approved.

The President then thanked the officers and participants in the Session, as well as the Turkish Sugar Institute staff and interpreters, after which the working meetings closed. The final event of the week was the

excellent Banquet given by the Turkish Sugar Factories Corporation to delegates to the 16th Session.

A large number of the delegates subsequently stayed in Turkey and participated the next day in an excursion by bus to Göreme where they were able to inspect the strange landscape produced by wind erosion of soft limestone rock. Explosion of a volcano had deposited hard basaltic rock on top and in places the limestone pinnacles carried separate slabs of basalt, balanced on the tops. A visit was made to a series of churches carved in the rock, painted inside with ikons and in use from about 1300 A.D. until 1924 when the Greek-Turkish exchange took place.

A similar community at Kaymaki existed in a subterranean city, built on seven levels and housing several thousand people. After spending the night at Göreme the delegates returned to Ankara and thence to Istanbul where they spent an evening and morning sightseeing before returning to their homes on the afternoon of the 10th June.

A list of the Subjects, their Referees and the recommendations accepted (as modified) at the 16th Session will be published at a later date.

Effects of thermophilic activity in diffusion on sugar beet processing

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Paper presented to the 22nd Tech. Conf., British Sugar Corp. Ltd., 1974.

PART I

Introduction

WHEN the Robert batch-type battery was the principal diffuser in use in the beet sugar industry, the results of microbiological action were often very evident particularly under the relatively cool conditions, 50°C or less, prevailing at the water end of the battery. With juice heaters between each cell, temperatures of 75–80°C were normally achieved throughout the centre cells of the battery but when the counter-current flow of juice encountered the cold fresh cossettes in the head cells, the lower temperatures again favoured thermophilic acitivity.

During the last 25 years, many Robert batteries have been replaced by continuous diffusers in which the main heating sources are external to the diffuser, thus giving a far more uniform temperature pattern throughout the diffuser. Commonly the diffusion supply water is heated to about 71–74°C and the fresh cossettes are scalded in a recirculation juice system so that they also enter the diffuser at about 71–74°C and, with efficient lagging, temperatures of at least 70°C can be maintained throughout the diffuser without direct heating.

Such a temperature profile gave rise to claims that microbiological activity was completely suppressed in some diffusers but in practice minimum temperatures of 70°C proved to be inadequate to prevent acid production by thermophilic bacteria without use of bactericides. The acid production was most prominent at some position between the centre and head of the diffuser, typically to produce a zone of minimum pH 5·4 to 5·2.

Effects of acid production in a battery are spread over all of the component cells as the head cell moves successively around the battery but in the continuous diffuser the localized nature of the region of low pH raised fears of a serious corrosion problem. It was found possible to suppress the thermophilic activity by frequent shock dosing with formaldehyde, injected directly into the diffuser, or by a rather lower formaldehyde dosage combined with slightly increased diffusion temperatures.

Suppression of the acid formation in continuous diffusers gives rise to other problems. The ammonia and calcium content of condenser water make-up contribute appreciable amounts of alkali to the diffusion supply water. In the absence of acid production, the pH through the diffuser would tend to rise from about pH 6·2 at the juice end to about pH 7·0 to 9·0 at the water end and the extraction of cossettes under these alkaline conditions yields a pulp which is more difficult to press to a high dry substance than pulp from diffusion under slightly acidic conditions. The effects of alkaline diffusion are aggravated if the diffusion temperature is also increased and some pectin may be dissolved causing a serious loss of pulp solids.

These effects on pulp can be largely avoided by addition of acid to bring the diffusion supply water to pH 5·0 to 5·5 but since the supply water is but feebly buffered, the low pH obtained by acidification with mineral acid at the water end cannot persist through to the higher Brix regions of the diffuser where the pH tends towards the natural beet juice pH of 6·1 to 6·4.

Consequently, there is a tendency to consider that better pulp pressing can be achieved when the pH

is kept low by fermentation than by external acidification, and it is not uncommon to permit some thermophilic activity in a vain attempt to achieve a controlled fermentation to aid pulp pressing.

The results of efficient pulp pressing are immediately obvious in the operation of the beet factory and so such a policy may appear to be successful, but the thermophilic activity has many insidious and undesirable effects on the factory process. It is the object of this review to collate the widespread effects on the beet sugar process of the activity of thermophilic activity in the diffusion system.

Control of pH in diffusion

Drying costs demand that the pulp leaving the diffuser should be pressed to as high a dry substance as possible and pulp pressing becomes appreciably more difficult if the pH in the diffuser rises significantly above pH 6·0 particularly if these conditions persist towards the water end.

To meet the requirements of heat economy and effluent disposal, condenser water is normally used to make up the pulp press water to the volume required for diffusion supply. The water passing through the condenser loses some of the carbon dioxide associated with temporary hardness and also takes up some ammonia from the condensed vapours and so the make-up water is appreciably alkaline. It is necessary to neutralize this alkalinity to achieve efficient pulp pressing. The alkalinity varies considerably from factory to factory and the acid required to adjust the diffusion supply water to say pH 5·5 generally amounts to between 0·2 and 0·4 kg equivalent per 100 tons of beet processed.

If this pH adjustment were to be achieved entirely by acidification of the diffusion supply water, some 10–20 kg (22–44 lb) of sulphuric acid or 24–48 kg (53–106 lb) of 30% hydrochloric acid would be required. Of these, sulphuric acid is much to be preferred, even though the handling difficulties are greater, because much of the added sulphate is precipitated by calcium during liming.

Some factories do indeed use amounts of acid in the above range to adjust the pH of diffusion water but some use much smaller amounts and achieve satisfactory pulp pressing by permitting some fermentation by thermophilic bacteria to complete the neutralization by acid production within the diffuser. There are those who maintain that higher pressed pulp dry substance can be achieved by this latter procedure and certainly a different pH profile in the diffuser is so obtained.

Fermentation in the relatively cool water end and in the pit of battery diffusers generally produces sufficient acid to neutralize much of the alkalinity of the make-up water but in contrast the water end and press water from continuous diffusers are comparatively inactive owing to the external heating system. Fermentation therefore produces but little acid at the water end and the bacteria are most active between the centre and head of the diffuser. Consequently fermentation can produce a pH profile showing a fall from raw juice to a minimum part way towards the centre of the diffuser and then a slow rise towards the water end, while in the absence of fermentation, even if the supply water is adjusted to say pH 5·2, there is a fairly rapid rise along the diffuser as the Brix increases to give about pH 6·0 in the centre of the diffuser with a continued rise to about pH 6·2 at the head of the diffuser[1].

It would be possible to produce a region of low pH towards the head of the diffuser without fermentation if mineral acid were injected into this region though with the RT-type diffusers an acid-resistant rotating junction would be required to transfer the acid to positions within the rotating drum.

However, it is very uneconomical to try to achieve this pH profile by means of a controlled fermentation. Without acidification it would be necessary to produce some 18–36 kg of lactic acid per 100 tons of beet (150–320 mg per litre of raw juice) merely to neutralize the excess alkalinity supplied by the make-up water.

In fact it is not possible to achieve a controlled fermentation either by continuous or shock dosing with bacteriostats and if periods of high pH are to be avoided, periods of excessive activity are inevitable and under these conditions the lactic acid production may exceed 500 mg per litre, representing a costly but not readily measurable sugar loss of about 0·1% on beet.

Ratio of sucrose lost to lactic acid produced

Previous work has shown that one of the most important effects of thermophilic bacterial action in diffusion is the production of lactic acid from sucrose. It was also shown that lactic acid was the principal acid formed[1,2]. In view of this it could be of great value if the ratio of sucrose lost to lactic acid produced were known in order that diffuser losses by bacterial activity could be deduced.

Sucrose loss occurring by thermophilic activity cannot be estimated directly in factory diffusers because the uncertainties of calculating a sugar balance in diffusion are greater than the sugar loss normally due to thermophilic activity. On the other hand methods are available to measure lactic acid in juice very accurately[3,4] or with sufficient accuracy for factory control purposes (See Appendix) such that the sucrose lost might be deduced from the lactic acid formed.

NORMAN & RORABAUGH[5] found ratios of sucrose lost to lactic acid formed ranging from 0·81 to 4·44 and averaging 2·14 by incubating diffusion juices at 60–65°C for 24 hours. These authors pointed out that one mole of lactic acid produced from a mole

[1] CARRUTHERS & OLDFIELD: *Paper presented to the 8th Tech. Conf., British Sugar Corp.*, 1955; *Zeitsch. Zuckerind.*, 1955, **80**, 483–488.
[2] SHORE: *Proc. 10th Gen. Assembly C.I.T.S.*, 1957, 196–202.
[3] OLDFIELD & SHORE: *I.S.J.*, 1970, **72**, 3–4.
[4] OLDFIELD, PARSLOW & SHORE: *ibid.*, 35–40.
[5] *Proc. Amer. Soc. Sugar Beet Tech.*, 1954, **8**, (2), 242–247.

of sucrose would give a weight ratio of 3·8 and the theoretical maximum yield of 4 moles of lactic acid from one mole of sucrose would give a ratio of 0·95. They concluded that their practical results were therefore of the right order of magnitude and that the ratios might vary from area to area, year to year and perhaps even cell to cell within the diffusion battery.

CARRUTHERS *et al.*[6] using cultures of raw juice inoculated with soil found ratios of sucrose lost to lactic acid formed ranging from 1·21 to 3·12 with an average of 1·96 and concluded that in assessing losses due to bacterial action in diffusion the best approximation would be obtained if it was assumed that the sucrose loss was equal to twice the amount of lactic acid produced.

KLAUSHOFER & POLLACH[7] have also investigated this problem and found that, according to the type of thermophile, between 0·8 and 1·1 meq of acid was obtained per 100 mg of sugar. Assuming that the acid was all lactic acid these results represent ratios of sucrose lost to lactic acid formed ranging from 1·0 to 1·39—results which are in a much narrower range than those reported previously. It may be that differences in procedure have yielded different results because the latter workers used microbiological culture media for their experiments whereas NORMAN & RORABAUGH and CARRUTHERS *et al.* used beet juices.

Further experiments along the lines described by CARRUTHERS *et al.* have been carried out in an attempt to gain a greater insight into the problem. The experiments have been carried out with unsterilised raw juice produced in the laboratory micro-battery. The production of less than 0·04% (400 ppm) of lactic acid reduces the pH sufficiently to inhibit further activity[6] and it is not practicable to determine the correspondingly small sucrose loss with precision.

Experiments to compare sucrose loss with lactic acid formation therefore have to be carried out such that as lactic acid is produced it is automatically neutralized. This is achieved using a pH meter and an autotitrator controlling the addition of sodium hydroxide to the incubated juice to maintain a pH of 5·8 to 6·0 at 65°C. These incubations are carried out generally for at least 16 hours to guarantee that a measurable loss of sucrose occurs. In a recent series of experiments the ratio of sucrose lost to lactic acid formed was found to range from 1·38 to 4·37 with an average of 2·29, results which are generally in keeping with those reported by NORMAN & RORABAUGH and CARRUTHERS *et al.*

In most of the pH-controlled incubations, in addition to a large loss of sucrose a much smaller loss of invert sugar is observed and the postulate that significant quantities of lactic acid might be produced by the action of thermophilic bacteria on invert sugar has been tested. For these tests the laboratory micro-diffuser samples were treated in every other way like the incubations to determine lactic acid production from sucrose except that before incubation the sucrose in the samples was completely hydrolysed to invert sugar by treatment with commercial invertase concentrate.

In these experiments there was no detectable production of lactic acid but there was a small amount of acid formed. The acid so produced has not been identified although investigations are proceeding to do this. This finding confirms that the main source of lactic acid is sucrose and not invert sugar. However, in considering the breakdown of sucrose to lactic acid many questions remain to be answered. The fact that the yield of lactic acid varies has prompted investigations into the production of other metabolites, in particular carbon dioxide and the polysaccharide gums levan and dextran.

In all the experiments carried out no significant quantities of these polysaccharides have been found and, although carbon dioxide is a major metabolite, even when this is taken into account the yield of lactic acid and carbon dioxide is insufficient to account for all the carbon atoms represented by the sugar loss.

As yet, therefore, a complete picture of the interconversions involved has not been obtained, but the results do confirm the earlier work and show that in calculating sucrose loss the best approximation is obtained if the sucrose loss is taken to be twice the amount of lactic acid formed.

Effect of acid production on juice stability

The raw juice from the diffuser contains about 38 meq to 52 meq of anions/100S and so the additional production of some 2 to 5 meq/100S of lactic acid by thermophilic bacteria may appear to be of minor importance. The stability of the juice to resist loss of pH during the evaporation and crystallization stages, however, is not a function of the total acid content only but is dependent on a delicate balance between the quantity of acid eliminated in liming in relation to the quantities of base eliminated and of acid produced. In this balance the unnecessary production of a few milliequivalents of acid by thermophilic bacteria can be of critical importance.

Raw juice is a relatively dilute solution of sucrose in water containing a complex mixture of cations, anions and polymeric material, such as proteins and pectins, in solution. Some of these components are eliminated during liming and carbonatation while some remain in the clarified juice, and so the composition of the raw juice and the manner in which it is produced and then processed will determine the suitability of the acid-base balance for the remaining process stages[8].

During liming and carbonatation there is a loss of acidity due to elimination of insoluble calcium salts of phosphate, oxalate, citrate, malate and sulphate

[6] *Paper presented to the 11th Tech. Conf., British Sugar Corp.*, 1958; *Zeitsch. Zuckerind.*, 1958, **83**, 541–546.
[7] *Zucker*, 1972, **25**, 157–165.

anions. This loss is partially balanced by acid production due to the degradation of invert sugar to yield predominantly lactic acid with some formic, acetic, glycollic and mixed saccharinic acids[2,9]. The elimination of acidity is further offset by some elimination of bases; magnesium is almost completely eliminated[10] and glutamine, the principal amino-acid in raw juice, is decomposed to form pyrrolidone carboxylic acid and ammonia[10]. Some of this ammonia together with that entering in diffusion supply water is lost during carbonatation.

The residual glutamine and amino-acids are buffers and so there is a significant base requirement to raise the pH of raw juice to that of second carbonatation juice.

A typical balance for the above changes in the absence of lactic acid production in diffusion is reported in Table I, showing a net gain in base of 7 meq/100S and this amount less the lactic acid in diffusion is the alkalinity available to give stability to the juice and for the formation of the carbonate-bicarbonate system in second carbonatation, which in turn determines residual lime salts.

A typical white sugar factory would require to absorb the sulphur dioxide produced by burning about 43 lb sulphur/100 ton beet, corresponding to an acid addition of 6 meq/100S. On this balance, all but 1 meq/100S of the available base has been used up without allowance for any lactic acid production in diffusion. In this context, production of lactic acid in the range 0·5 meq to 5·0 meq/100S is critical to the success of the factory operations. If the thermophilic bacteria were produced at a constant rate, it would be possible to add additional soda ash or reduce the sulphur usage correspondingly; each extra production of 1 meq lactic acid/100S requires the addition of 20 lb soda ash/100 tons beet or a reduction in sulphur usage of 7 lb/100 tons beet.

Table I. Acid-base balance for processing of a typical raw juice of 89 purity

Gain in base or loss of acid

	meq/100*S*
Ammonia from diffusion supply water	1·5
Loss of phosphoric acid in carbonatation ..	8·8
Loss of sulphuric acid in carbonatation ..	2·5
Loss of oxalic acid in carbonatation	9·2
Loss of citric acid in carbonatation	9·5
Loss of malic acid in carbonatation	1·0
Loss of raw juice carbonate in carbonatation	0·6
Total	33·1

Gain in acid or loss of base

	meq/100*S*
Mineral acid from diffusion supply water ..	0·8
Loss of magnesium in carbonatation	12·2
Loss of calcium in carbonatation	1·2
Loss of ammonia in carbonatation	2·7
Acids from invert degradation in carbonatation	5·4
Base to raise raw juice to second carbonatation pH	3·8
Total	26·1

Net gain in base = 7 meq/100S

In practice the lactic acid production in diffusion can fluctuate rapidly, so presenting additional difficulties in trying to regulate the soda ash addition and sulphur usage to give a stable juice.

(*to be continued*)

[8] CARRUTHERS *et al.: Paper presented to the 7th Tech. Conf., British Sugar Corp.*, 1954; *I.S.J.*, 1954, **56**, 218.
[9] CARRUTHERS & OLDFIELD: *Paper presented to the 12th Tech. Conf., British Sugar Corp.*, 1959; *Zucker*, 1960, **13**, 330–339, 364–366.
[10] CARRUTHERS *et al.: ibid.*; *Zeitsch. Zuckerind.*, 1960, **85**, 350–354.

Resistance of sugar cane varieties to top borer Tryporyza nivella (Fabricius)

By R. A. AGARWAL*, DHAMO K. BUTANI* and C. B. TIWARI†

Introduction

Tryporyza nivella (Fabricius) is one of the most serious of sugar cane pests. It is widely distributed in the Old World. The young cane shoots are completely killed, while attack at a later stage results in formation of a bunchy top. The thin canes are non-millable and there is considerable loss in sugar recovery. According to AVASTHY[1] this borer causes, in India, a decrease in tonnage of 20 to 85% and a fall of 0·48–4·05 units in sugar recovery. Studies on the losses in quality and quantity of canes have also been made by various workers[2,3,4,5,6,7].

Resistance to top borer may be associated with various characteristics of cane varieties and claims have been made by various authors that resistance to

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[1] "Pests of sugar cane", Ed. J. R. WILLIAMS *et al.* (Elsevier, Amsterdam) 1969, pp. 189–205.
[2] ISAAC: *Curr. Sci.* (India), 1939, **8**, 211–212.
[3] HAQUE and AGARWALA: *Indian Sugar*, 1955, **5**, 13–20.
[4] AGARWALA and PRASAD: *ibid.*, 1956, **6**, 60–66.
[5] GUPTA: *ibid.*, 1959, **9**, 127–149.
[6] BUTANI: *ibid.*, 1966, **16**, 33–38.
[7] KALRA and CHAUDHRY: *Indian J. Sugarcane Res. Dev.*, 1964, **8**, 261–264.

the pest is associated with high leaf area index[8], with hardness of the midrib and of the spindle[2, 9, 10, 11, 12, 13], with density of vascular bundles and associated sclerenchymatous sheath[14], with length of spindle and degree of resistance to pokkah boeng (*Fusarium monoliforme* Sheld)[15], with rind hardness[16], with percentage dry matter in the leaf spindle[10, 17], with time of maturity[18, 19], and with ability to tiller[20].

Perusal of this literature indicates that the relationships between morphological and anatomical characteristics and top borer resistance are obscure and the incidence of attack has been shown to vary, not only with ecological conditions but also in different varieties grown under the same ecological conditions. Detailed studies were, therefore, undertaken to classify important commercial varieties with respect to top borer resistance.

Method

Twenty-seven sugar cane varieties (Table I), grown as plant cane and first ratoons, were examined for incidence of top borer (*T. nivella*) during December-January for two consecutive crops. Of these, eight varieties, namely P 12235 (early), Co 1007 and CoL 9 (mid-season), Co 1107, Co 1148, Co 1328, G 12061 and CoJ 46 (late) were selected for detailed study.

Table I. Incidence of top borer in different varieties

Early maturing varieties	% *Incidence*		
	Plant	*First ratoon*	*Plant*
Co 1266	29·4	50·4	19·0*
Co 1318	30·5	62·1	11·6
Co 1324	21·7	65·0	—
CoL 29	22·8	65·9	24·8*
P 12235	35·3	60·9	19·8*
Co 1332	—	—	27·7*
B 37172	—	—	12·5
CP 34/79	—	—	7·7
Average	28·0	60·9	17·6
C.D. at 5%	N.S.	N.S.	11·2
Mid-maturing varieties	% *Incidence*		
	Plant	*First ratoon*	*Plant*
Co 975	24·3	54·6*	24·5*
Co 1007	19·7	17·5	6·6
Co 1158	27·8	32·7	18·9
Co 1167	35·4*	71·0*	25·1*
Co 1305	21·4	65·2*	—
Co 1330	20·0	56·9*	2·5
Co 1332	29·5	71·4*	—
CoL 9	78·0*	78·0*	34·9*
G 12061	31·8	35·2*	5·8
Average	32·0	53·6	16·9
C.D. at 5%	10·3	15·8	16·8
Late maturing varieties	% *Incidence*		
	Plant	*First ratoon*	*Plant*
Co 617	11·6*	61·5*	8·5
Co 1107	15·0*	64·9*	27·7*
Co 1137	10·3*	26·5	—
Co 1148	5·2	26·5	9·8
Co 1235	16·8*	44·4*	—
Co 1236	11·0*	59·6*	25·8*
Co 1328	12·2*	51·0	16·3
G 12051	14·4*	35·2	—
P 11996	9·5*	29·3	—
CoJ 46	13·5*	30·0	2·2
Average	11·9	42·9	15·1
C.D. at 5%	14·1	12·5	19·5

— Varieties not available

* Significant at 5% level

N.S. Non-significant

Canes falling within 5% of the row length were cut at ground level from all the seven replications and borer damage recorded. Ten stalks each of healthy and damaged cane were picked at random from each replication and examined for length, number of internodes, girth, weight, sucrose content and available sugar % cane. The data are presented in Tables II and III. The variety showing the least loss was rated as first, with increasing losses in serial succession. The rated values of different varieties are given in Table IV.

Results

It was observed that early and mid-season maturing varieties suffered comparatively more than the late-maturing varieties both in the case of plant cane and in first ratoons (Table I). There was, however, no difference in the percentage incidence of top borer between the early and mid-season maturing varieties in the case of the plant crop. Within the group of varieties there were marked differences in pest incidence during the two respective years. These differences were probably due to ecological conditions adversely affecting the rate of development and multiplication of the pest rather than to differences between the varieties under test.

Nevertheless there was a higher incidence in first ratoons than in plant cane, irrespective of time of maturity. This may be due to the ratoon crop being exposed to the top borer moths for a longer period than the plant crop. The ratoon crop is available for over-wintering moths from the beginning of March until November, whereas the plant crop is in a vulnerable stage only from May onwards. Thus the plant crop escapes the damage from at least one generation of the pest.

Loss in length of stalk: The mean decrease in stalk length was 26·8% in the plant crop (Table II) and 28·4% in the first ratoon crop (Table III). The decrease

[8] ADLAKHA: *ibid.*, 343–344.

[9] HAZELHOFF: *Proc. 3rd Congr. Int. Soc. Sugar Cane Tech.*, 1929, 168–171.

[10] *idem: Proc. 4th Congr. Int. Soc. Sugar Cane Tech.*, 1932, 169.

[11] RAO and VENKATARAMAN: *Curr. Sci.* (India), 1941, **10**, 171–172.

[12] RAO: *ibid.*, 365–366.

[13] *idem: Indian J. Agric. Sci.*, 1947, **17**, 203–210.

[14] AHMAD: *Sci. Rpt. for* 1940–41 (Agric. Res. Inst., New Delhi), 1942, 64–65.

[15] KHANNA and RAMANATHAN: *Indian J. Ent.*, 1946, **8**, 178–185.

[16] RAO *et al.: Proc. 9th Congr. Int. Soc. Sugar Cane Tech.*, 1956, 895–901.

[17] HART: *Arch. Suikerind. Neduicia*, 1932, **40**, (5), 43; *Facts about Sugar*, 1933, **28**, 12–14.

[18] GUPTA: "A consolidated report of the work done in India under insect pests schemes during 1952–53" (Indian Central Sugarcane Committee, New Delhi.) 1954.

[19] AGARWAL: *Indian Sugar*, 1959, **8**, 785–796.

[20] JEPSON: "A critical review of the world literature on the Lepidopterous stalk borers of tropical graminaceous crops" (Commonwealth Inst. of Entomology, London.) 1954. 127 pp.

Table II. % Loss in different varieties (plant) due to top borer damage

Loss in	Co 1007	Co 1107	Co 1148	Co 1328	CoL 9	CoJ 46	G 12061	P 12235	*Average*	C.D. at 5%	C.D. at 1%
Length	22·6	31·7	11·6	47·6	16·6	18·8	33·9	32·2	26·8	7·6	10·4
Internodes	32·8	35·5	22·7	57·6	16·4	32·1	41·2	32·7	33·9	12·9	17·5
Girth	6·0	5·5	1·3	–4·6	–4·6	11·2	2·1	–2·6	1·8	4·1	5·6
Weight	26·0	43·0	6·8	55·2	20·1	28·4	34·6	34·4	31·1	9·1	12·4
Sucrose content ..	27·3	33·2	28·6	27·4	19·0	35·8	43·8	27·0	32·3	15·4	21·4
c.c.s.	37·3	35·0	33·9	45·8	21·4	34·7	48·9	31·5	36·1	11·5	16·0

Table III. % Loss in different varieties (ratoon) due to top borer damage

% loss in	Co 1007	Co 1107	Co 1148	Co 1328	CoL 9	CoJ 46	G 12061	P 12235	*Average*	C.D. at 5%	C.D. at 1%
Length	36·5	18·5	31·5	23·3	21·3	46·2	32·9	17·1	28·4	11·1	15·1
Internodes	42·2	18·4	32·2	27·0	32·7	45·8	39·0	14·5	31·5	8·5	11·6
Girth	13·3	3·0	16·3	6·7	4·2	23·1	15·7	7·3	11·2	10·0	13·4
Weight	18·4	24·0	29·4	33·4	21·7	62·2	50·3	11·7	31·4	10·3	14·0
Sucrose	14·3	18·5	14·6	26·2	15·2	22·1	25·7	12·0	18·6	10·8	14·7
c.c.s.	16·0	20·1	16·2	29·1	18·5	24·6	28·2	12·5	20·6	10·3	13·9

Table IV. Rated value of sugar cane varieties to different attributes as influenced by top borer

Attributes (percentage loss in)	*Plant (P) or Ratoon (R)*	Co 1007	Co 1107	Co 1148	Co 1328	CoL 9	CoJ 46	G 12061	P 12235
Length	P	4	5	1	8	2	3	7	7
	R	7	2	5	4	3	8	6	1
Internodes	P	5	6	2	8	1	3	7	4
	R	7	2	5	3	4	8	6	1
Girth	P	6	5	3	1	1	7	4	2
	R	5	1	7	3	2	8	6	4
Weight	P	3	7	1	8	2	4	6	5
	R	2	4	5	6	3	8	7	1
Sucrose	P	3	5	4	7	1	6	8	2
	R	2	5	3	8	4	6	7	1
c.c.s.	P	6	5	3	7	1	4	8	2
	R	2	5	3	8	4	6	7	1
Aggregate overall value..	P	4	5	2	6	1	4	7	3
	R	3	2	2	4	1	4	5	1

in length was significant in the case of the plant crop but non-significant in the case of the ratoon crop. The maximum loss in length in plant cane was as follows: Co 1328 (47·6%), G 12061 (33·9%), P 12235 (32·2%), Co 1107 (31·7%), Co 1007 (22·6%). CoJ (18·8%), CoL (16·6%) and Co 1148 (11·6%). The same varieties, as first ratoons, did not follow this sequence of decrease in length. The sequence of resistance, in decreasing order, was CoJ 46, Co 1007, G 12061, Co 1148, Co 1328, CoL 9, Co 1107 and P 12235.

Loss in number of internodes: There was a mean decrease of 33·9% and 31·5% in internode number in the plant (Table II) and first ratoon crops (Table III). The different varieties showed the same behaviour pattern and also followed the same sequence in reduced internodes as was observed for reduction in length in the different varieties. The correlation coefficient was positive ($r = 0{\cdot}81$ and $0{\cdot}80$) and significant at the 1% level.

Reduction in girth of canes: The girth of canes is also reduced by top borer damage. Nevertheless, in certain varieties in the plant crop (Co 1328, CoL 9 and P 12235) there was no reduction but rather an increase in girth (Table II). This may be due to borer injury slowing down elongation during the peak growth period. However, in the ratoon crop there was a significant decrease in girth of the canes (Table III). Variety CoJ 46 (plant and ratoon) appeared to suffer the most and CoL 9 the least reduction in girth.

Loss in weight: The varieties under test showed 6·8 to 55·2% and 11·7 to 62·2% loss in weight as a result of top borer damage in the plant and first ratoon crops, respectively (Tables II and III). The differences between varieties were highly significant. Varieties Co 1148 and P 12235 amongst the plant and first ratoon crops, respectively, showed the least loss in tonnage while Co 1328 (plant) and CoJ 46 (ratoon) showed the greatest loss.

Loss in sucrose and commercial cane sugar (c.c.s): Varietal differences in losses of sucrose and commercial cane sugar were very obvious. On average the varieties as plant cane showed 32·4 and 36·1% losses (Table II), whereas in first ratoons losses were 18·6 and 20·6% in sucrose and c.c.s. respectively (Table III). The losses were significantly higher in plants than in first ratoons. Varieties CoL 9 and P 12235 showed some resistance as compared to the other varieties tested.

Considering the varietal complex in relation to top borer incidence and the losses in length, internode number, girth, weight, sucrose and c.c.s. it may be concluded that a variety tended to maintain the resistant or susceptible behaviour for the different attributes studied when grown as plant or ratoon crop.

Summary

To study the resistance of top borer (*Tryporyza nivella*) to various sugar cane varieties, 27 varieties grown as plant and ratoon crops were examined for the incidence of this pest for two years. Of these, eight varieties, namely P 12235, Co 1107, Co 1007, Co 1148, Co 1328, G 12061, CoJ 46 and CoL 9 were selected for further studies. These studies revealed that CoL 9 was comparatively resistant to top borer, suffering the least loss in length, internode, girth, weight and sucrose content, both as plant as well as ratoon cane. The next best variety was P 12235. It is suggested, therefore, that in localities where top borer incidence is rather high, CoL 9 and P 12235 may be preferred both for plant and ratoon, as Co 1328, CoJ 46 and G 12061 are likely to suffer greater losses by top borer.

Sugar losses in beet washing

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PART II

Drum beet washers (French type)

In France the firms of Venot-Pic and Maguin construct beet washers consisting of a revolving drum with horizontal axis, with a layer of water inside. The beets travel from one end to the other rubbing each other. The rubbing effect is promoted by arms and paddles protruding from the inside of the drum.

These washers have no stone pockets and therefore they have to be followed by specially constructed stone separators (Figs. 7 and 8).

The main difference between the two types of drum washer is to be found in the method of feeding the beet and in the separation mechanism just mentioned. The Venot-Pic drum[6,7] is fed with dry beets transported by belts from the factory yard.

In this way, it is possible to create a mud slurry of such a high density in the separation vessel after the drum, that the beets float on the surface, whereas the stones sink and can be removed.

Slurry density is controlled by circulation via a hydrocyclone. The slurry is washed from the beets in countercurrent with a small amount of wash water afterwards.

The beets are fed into the Maguin drum[8] after normal fluming; the flume water is separated at the entrance to the drum and the wash water does not contain more mud than in the classical washer. The stones are separated afterwards in an upwardly directed water stream as usual. We do not have available much detailed information on drum diameters and drum rotation speeds or on residence times. During our measurements of sugar losses at three French factories in 1972, the washed beet looked very clean, with a residual tare of less than 0·5%, but we did not conduct special experiments on beets grown in sticky clay.

The results of our measurements of sugar losses in two Maguin drums of different capacity (2,500 and 5,400 tons of beet per day) gave identical results: 0·06% sugar on beet.

The losses in the Venot-Pic drum are more difficult to compare, as there is no fluming beforehand. We measured a total sugar loss of 0·09% which has to be compared with the total loss in fluming and washing together. Losses in fluming usually amount to between 0·05 and 0·08%, and on the same basis, the sugar losses in the Venot-Pic washer are 0·04% at the most.

The Venot-Pic washer is equipped with a transport scroll inside the drum (see Fig. 9) which reduces

[6] PLOUVIER: *Ind. Alim. Agric.*, 1971, **88**, 1089–1098.
[7] MORAILLON: *Sucr. Franc.*, 1971, **112**, 241–247.
[8] DENIS: *ibid.*, 1972, **113**, 353–356.

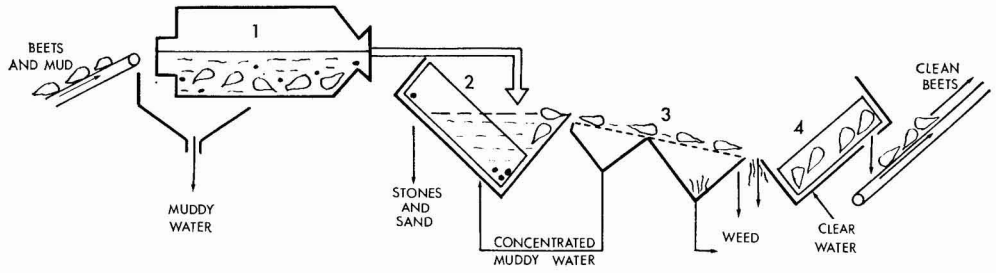

Fig. 7. Beet flow through Venot-Pic drum beet washer installation. (1) Drum washer, (2) "Drewboy"-type stone catcher, (3) vibrating weed screen, (4) "Drewboy"-type weed catcher

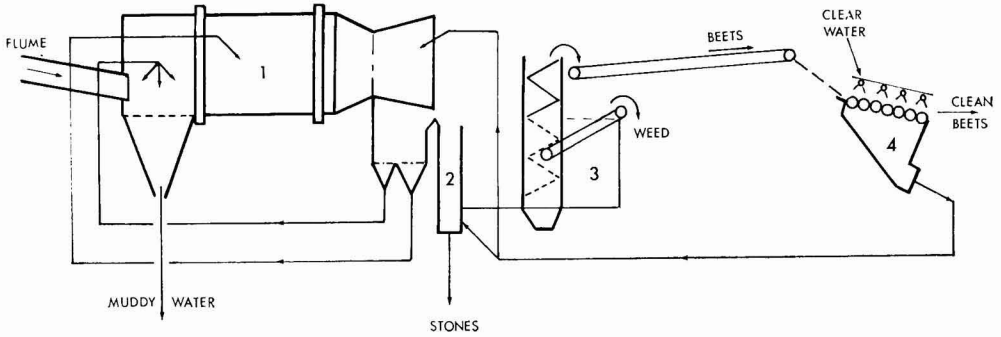

Fig. 8. Water and beet flow through Maguin drum beet washer installation. (1) Drum washer, (2) stone catcher, (3) weed catcher, (4) roller screen

the buffer capacity and residence time. This explains the lower sugar losses.

The buffer capacity of the Maguin drum can be judges from the beet contents as shown in Fig. 10.

All losses mentioned in this section on drum washers relate to the complete installation, i.e. including stone and weed catchers installed after the drum.

We may conclude from this section that drum washers produce cleaner beet with about 50% lower sugar losses in comparison with beet washers having revolving arms.

Spray washers

Spray washers are constructed as conveying devices, the surface of which should be large enough to spread out the beets in a layer of single beets.

Above the conveyor, and in one type also underneath, jets are installed in order to clean the beets by spraying water under high pressure (about 10 kg.cm^{-2}).

During their transport the beets should roll over in some way, in order to expose all sides to the sprays.

According to the method of conveying the beet, we can distinguish between:

— roller screen (Elfa)
— vibrating screen (Främbs und Freudenberg)
— perforated shaker conveyor (Raffinerie Tirlemontoise)

Sugar losses from spray washers

Our measurements in Holland and Belgium at four different factories all gave the same loss figure of 0·025% – 0·03% sugar on beet.

This may be a coincidence, in view of the differences in wash water pressure and residence time, as shown in Table II.

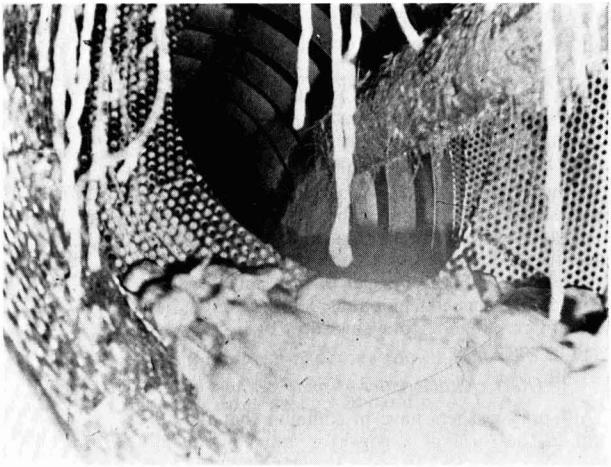

Fig. 9. Interior view of Venot-Pic drum-type beet washer showing transport scroll, wash water inlet pipe and discharge screen

Fig. 10 Maguuin drm-type beet washer filled with beets during operation

Table II

	Sugar loss on beet %	*Wash water pressure* $kg.cm^{-2}$	*Residence time, seconds*	*mg sugar lost per minute per kg of beet*
Roller screen (Elfa)	0·025	5	unknown	—
Vibrating screen (F und F)	0·025	5	"	—
	0·030	7	44	400
Shaker conveyor (RT)	0·025	11	22	680

A comparison of the calculated losses in $mg.kg^{-1}.min^{-1}$ with those of Fig. 5, reveals that they are of the same order of magnitude as those of the classical rotating-arms beet washer. The obvious difference between the two types of apparatus is that the higher efficiency of the cleaning operation by the water sprays allows for a residence time of about half a minute instead of between two and three minutes.

Loss measurements at different water pressures indicate that the losses are proportional to the square root of the water pressure.

If this holds true, the losses in the first two mentioned installations at 11 $kg.cm^{-2}$ would rise to 0·037% on beet, equivalent to a loss per minute of 500 $mg.kg^{-1}$ in the Främbs und Freudenberg screen washer.

As with drum washers, spray washers do not catch stones and therefore the sugar losses in the stone and trash catchers, installed after the washer, have to be included in the total. At our Breda factory a loss of 0·006% sugar on beet was measured and we may thus conclude that 0·03% to 0·04% is a normal figure for the total sugar loss of a spray beet washing installation.

Other characteristics of spray washers

All spray washers have in common that they are built in the form of a conveyor and consequently lack buffer capacity. In order to clean the beets well, these machines should work under constant load and never be overloaded. This restriction asks for special care in the organization of unloading, spraying from the yard and fluming. In Belgium a beet feeder wheel is considered indispensable.

Elfa roller screen

This type of washer was tested at our Halfweg factory. It was installed only provisionally, as a bypass, insofar as there are no stone catchers placed after it. In addition, the installation with its positive roller transport has no buffer capacity whatever. For these two reasons the factory management only reluctantly put the installation into operation and we therefore had little opportunity to make measurements. We did not measure the residence time nor the tare remaining after washing.

During their transport the beets are constantly rolling over, exposing all sides to the cleaning action of the sprays. There is no possibility of installing sprays underneath, but the sprays on top can be mounted relatively low above the moving beet.

The rotating rollers constitute a multitude of moving parts, which may give rise to the need for maintenance because of wear.

Främbs und Freudenberg vibrating screen

The apparatus, installed at Breda, has been working very reliably during four campaigns. The installation sometimes had to handle about twice as many beets as it was designed for, transporting the beets in at least two layers. Under such circumstances the dirt could not be washed off efficiently.

The vibrating screen has slots of 5 mm which do not allow spraying from underneath.

The washer stands uncovered in the open air, allowing inspection of every part in full operation.

The installation will be entirely rebuilt in 1974 and brought up to capacity, which will allow a better assessment of this type of spray washer.

Perforated shaker conveyor of Raffinerie Tirlemontoise

We were able to test this new apparatus[9] at the factories of Quévy and Veurne in Belgium during the 1973 campaign.

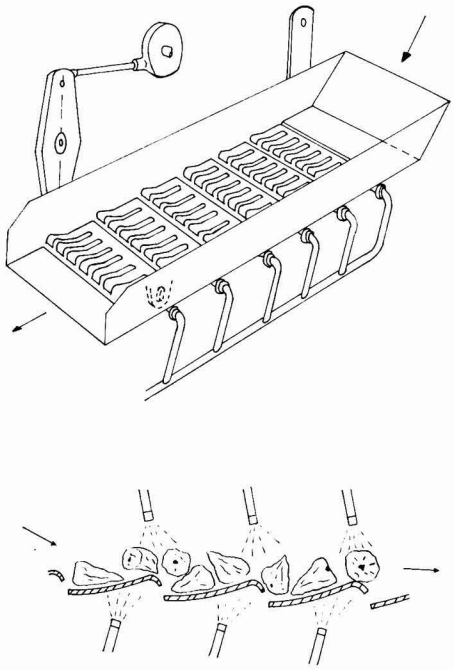

Fig. 11. RT shaker-conveyor beet washer with slots and spray nozzles

[9] BAUSIER: *Sucr. Belge*, 1973, **92**, 185-192.

The most important difference from the two types of spray washer above is that the construction of the conveyor allows for 30 mm wide slots, through which the beets can be sprayed from nozzles underneath (Fig. 11). The curved form of the plates, arranged like root tiles with steps in between, should result in turning of the beets for all-round cleaning. This, unfortunately, cannot be observed, as the installation is entirely closed (Fig. 12).

At Veurne, where the beets partly grow in a clay soil of stickiness similar to that encountered in the Netherlands, the residual tare amounted to about 0·5%.

For further testing a lorry load of the dirtiest beets to be found in our country was sent to Quévy and washed in our presence. We determined the residual tare from a very large sample, and found 0·8%, a really excellent achievement.

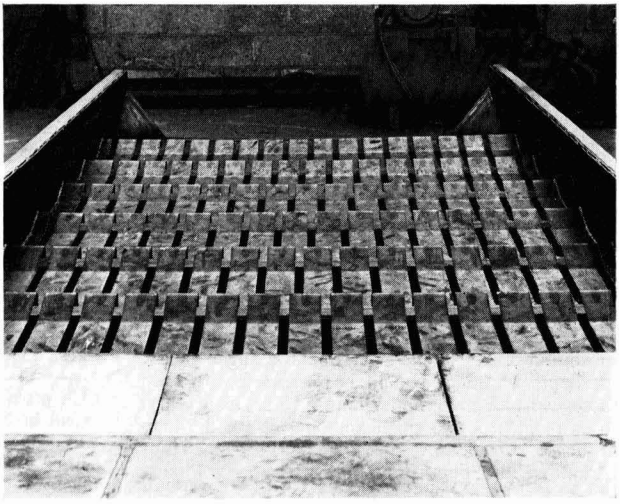

Fig. 12 Bed of RT beet washer

Comparison of Washer Performance

From the point of view of sugar losses, we can roughly state that use of the classical revolving-arms washers results in a loss of 0·09–0·15% sugar on beet, drum washers 0·04–0·06% and spray washers 0·03%–0·04%.

Replacing a classical washer by a spray washer will save 0·09% of sugar, that is 0·9 kg per ton of beet. An additional saving of comparable magnitude is made in the cost of cleaning the effluent (containing 1·2 kg less COD per ton of beet).

In an earlier section we have seen that the classical washer will only show lower sugar losses at the cost of higher amounts of tare remaining after washing. Drum and spray washers on the contrary not only show lower sugar losses but also better wash results. We do not have available accurate comparisons on the efficiency of tare removal by the last two mentioned types, but we feel that the result of the experiment with dirty beets at Quévy can hardly be surpassed.

Revolving-arms washers and one type of drum washer both have a good buffer capacity; the installations feeding beets to a spray washer should meet higher standards regarding regularity of flow required.

Stone catchers are only incorporated in the classical type of beet washer. We do not give much weight to this disadvantage, however, as every factory nowadays is involved in constructing or maintaining elaborate recycling water systems with all kinds of stone and trash separators.

Notwithstanding this, it must be stressed that all these separation systems, installed before and after the washer, must be considered as a part of the whole, and clear judgement of the performances of installations can only be obtained by comparing the total efficiency and cost of integrated installations.

Summary and Conclusions

The reduction of sugar losses, originating from the beet washing operation, is of importance both in regard to sugar yield and water pollution. The beet washing operation is one of the less studied unit operations in the beet sugar factory.

In the present paper are shown the results of comparative measurements made using three different types of beet washing apparatus.

In the classical revolving-arm type beet washer, it appeared to be impossible to combine clean beets and low sugar losses. An efficient cleaning operation resulted unavoidably in sugar losses of about 0·09–0·15% sugar on beet. The French drum-type washer seems to do a better job, producing clean beets with sugar losses no higher than 0·04–0·06%.

However, in this case, we conducted no experiments on beets grown in sticky clay soil.

The best results were shown by the various types of spray washer. Sugar losses at all installations studied amounted to 0·03–0·04% on beet. In this case the following conditions are essential to the production of clean beets:—

a spray water pressure of 10 kg.cm^{-2},

beets in a layer only one root high, and

repeated turning of the beets.

In this respect the Belgian RT type spray washer has the advantage of spraying the beets both from above and underneath, performing an efficient cleaning operation in only 22 seconds.

A final judgement of the performances of different installations can only be obtained by comparing the total efficiency and cost of integrated installations, (including stones and weed catchers and the return water system).

Sugar cane agriculture

Is deep tillage a must for sugar cane ? R. P. HUMBERT. *World Farming*, 1973, **15,** (8), 6–7.—While deep tillage (to below 35 cm) is not necessary in deep fertile soils, it is recommended in shallow surface soils underlain by hardpans or dense, compacted subsoils in order to increase cane and sugar yields; the depth of tillage should be increased with each successive ploughing and planting (every 5–6 years) so as to incorporate small amounts of the hardpan or dense subsoil into the tilled surface soil, thus permitting the depth of rooting to be gradually increased. Tillage is also often necessary when soil compaction occurs as a result of harvesting in wet weather, although it is emphasized that tillage should not be carried out until the soil is dry. Illustrations indicate the advantage of bagasse incorporation on a heavy clay soil with regard to improved internal drainage, and the benefits of phosphate application to soils, such as lateritic tropical subsoils which are often deficient in phosphorus and permit only surface rooting.

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Cane fertilization experiments. J. FRITZ. *Rpt. Inst. Recherche Agron. Trop. Réunion*, 1972, 21–40. N-P-K fertilizer trials at various locations in Réunion are reported and results given in the form of graphs and tables. Details are also given of the quantities of N, P, K, Ca, Mg, Na and S found in samples of cane pulp dried to constant weight at 50°C.

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Cane borer control. J. ETIENNE. *Rpt. Inst. Recherche Agron. Trop. Réunion*, 1972, 41–48.—Detailed information is given on the borer parasite breeding programme in Réunion.

* * *

Leafhopper (*Pyrilla perpusilla* Walker) of sugar cane. P. N. AVASTHY. *Indian Sugar*, 1973, **23,** 11–14. Knowledge of the cane leafhopper, one of the major insect pests of cane in south-east Asia, is summarized under breeding habits and life cycle, alternative hosts, cane varietal resistance, causes of severe infestations, nature and effect of attacks and measures of chemical and biological control.

* * *

Hot air therapy of sugar cane against grassy shoot and ratoon stunting diseases. K. SINGH, U. S. SHUKLA and N. S. L. SRIVASTAVA. *Indian Sugar*, 1973, **23,** 43–47.—Hot air treatment of setts for 7 hr at 54°C proved more effective in controlling grassy shoot and RSD than did hot water treatment for 2–2½ hr at 50°C when the setts were treated in bundles. The hot air treatment used with five cane varieties in experiments increased cane length, girth and row population compared with untreated cane, these results applying both to plant and ratoon crop.

* * *

The problem of low sugar recovery and low sugar cane yield in Northern India and remedies for improving the same. J. B. SAWHNEY. *Indian Sugar*, 1973, **23,** 49–53.—Means of increasing cane and sugar yield are discussed, including harvesting mature cane, maintaining adequate irrigation, controlling pests and diseases, reducing delays between harvesting and processing, minimizing the amount of extraneous matter and maintaining efficient cane transport systems; in the factory, losses in milling, filtration and molasses as well as undetermined losses should be reduced.

* * *

Studies on the life history of *Apanteles flavipes* Cameron and trial with it for controlling the Gurdaspur borer of sugar cane, *Bissetia staniella* Hampson in the Punjab. O. S. BINDRA and N. CHAND. *Indian Sugar*, 1973, **23,** 55–59.—Breeding of *Apanteles flavipes*, a borer parasite, was investigated in tests in which *Chilo partellus* proved a better host in the laboratory than did *Bissetia steniella* or *Chilo infuscatellus* in terms of percentage parasitization, rate of development, number of adults produced on a single host larva and the ease with which the eggs were inserted in the host and hatched. Release of the parasites in cane infested with *B. steniella* reduced the percentage of canes damaged from 11·7 to 9·2 and from 10·7 to 7·8 (at two different sites).

* * *

Characterization and classification of the soils of the sugar cane belt of Uttar Pradesh—survey of Iqbalpur Zone (District Saharanpur). H. S. SRIVASTAVA, S. C. JAUHARI and –. INFANUDDIN. *Indian Sugar*, 1973, **23,** 61–66.—The mechanical, physical and chemical properties of the three main soils in the area (all alluvial) are described.

* * *

Evaluation of chemical ripeners for sugar cane having constant nitrogen and water régimes. II. Superior activity of C.P.41845 (Monsanto). A. G. ALEXANDER and R. MONTALVO-ZAPATA. *Trop. Agric.* (Trinidad), 1973, **50,** 307–318.—Of five ripeners tested under glasshouse conditions over a period of 33 days, C.P. 41845 ("Polaris") proved the best in terms of

increased leaf sugar content, reduced green weight and internode length. It also significantly decreased acid invertase activity and water-soluble protein content. However, it also reduced ratoon growth, which could be a disadvantage under field conditions.

* * *

Wilt assumes a serious problem in the sugar cane riverine belt of Sarswati Sugar Mills area, Yamuna Nagar (Ambala). O. P. SINGH. *Indian Sugar*, 1972, **23**, 129–130.—Reference is made to a serious outbreak of wilt disease in association with marked stalk borer damage during 1971/72 in this area of India. An overall loss in weight of over 31% was recorded for the spring- and autumn-planted crops; the juice, of below 10°Bx, was dirty in colour and had a noticeable smell. The fact that wilt is usually associated with more than one organism and occurs together with red rot or borer infestation is discussed.

* * *

Quality of sugar cane influenced by age of tillers. T. R. SRINIVASAN, M. R. IRUTHAYARAJ and Y. B. MORACHAN. *Indian Sugar*, 1973, **23**, 131–134.—Investigations showed that the maximum number of tillers was formed between 35 and 95 days after planting, but that the percentage survival was greatest in those tillers formed in the early growth stages, i.e. within 75 days of planting. These tillers gave somewhat greater millable cane lengths, girths and weights than did the primaries and late-forming tillers. While both primaries and early-formed tillers contributed more to cane weight and sugar content in 285-day cane than did the later-forming tillers, at 370 days the late-forming tillers provided more sugar than did the other tillers which showed a maximum at 327 days and decreased thereafter.

* * *

Response of sugar cane varieties to withholding of water for different durations in the pre-monsoon period. U. S. SINGH and M. SINGH. *Sugar News* (India), 1973, **5**, (1), 25–28.—Experiments showed that omission of irrigation during the pre-monsoon period caused a drop in cane yield, the effect increasing with increasing time up to irrigation (60, 75, 90 and 105 days), although there was insignificant difference between the results for the first two periods, so that irrigation may be deferred for up to 75 days after planting. Significant differences were found between results for different varieties.

* * *

Effects of gamma irradiation on growth and RNA (ribonucleic acid) content of sugar cane. C. C. LO. *Rpt. Taiwan Sugar Expt. Sta.*, 1972, (57), 1–12. Moderate doses of irradiation (up to 14 kr) of cane with α-rays from ^{60}Co caused stunting, sett root growth inhibition and leaf shrinkage, while small doses (2 kr) caused stimulation of sett root growth and increased plant height. The radio-sensitivity of healthy buds on the lower parts of the stalks was smaller than those on the upper part. Variation in juice Brix at early stages of maturity was greater in irradiated cane and the sugar content generally lower than in the unirradiated cane. The RNA content was little affected by irradiation.

* * *

Studies on the yield of long-term sugar cane in relation to different planting and harvesting times. C. T. HUANG *et al. Rpt. Taiwan Sugar Expt. Sta.*, 1972, (57), 13–28. Experiments at five locations with three cane varieties are reported, in which the effects of planting and harvesting times on cane and sugar yields were examined. The results indicate the possibility of extending the cane age to 2 years before harvesting (considered to be of possible economic advantage).

* * *

Sugar cane breeding philosophy for the Philippines. L. T. EMPIG. *Proc. 20th Ann. Conv. Philippines Sugar Tech.*, 1972, 65–68.—For maximum sugar production in the Philippines, where the cane growing season extends over 10–14 months, it is advocated that cane tillering be limited to 3 months, followed by a 4–5 month period for elongation and enlargement of the stalks. The number of tillers produced (7–9) would all become harvestable stalks and the reduction in yield due to the smaller number would be balanced by increase in the number of stools per ha. However, since present varieties in the Philippines tiller profusely but give only 5–9 harvestable stalks, while the tillers that die contain sugar which is lost, it is proposed that cane be planted 30 cm apart in rows 75 cm apart to give a planting rate of 44,444 points per ha. But, again, not all present varieties are suitable for narrow planting, although tests are being conducted on closer planting, which reduces lodging and helps control weeds. Preliminary results indicate increased tiller survival and hence increased sugar content. Greater cane sensitivity to N application has also been observed; 100 kg N per ha gives a cane yield of 80 tons.ha^{-1} while 150 kg N per ha gives 150 tons.ha^{-1}.

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Some uses of tissue culture in sugar cane research. R. C. BARBA. *Proc. 20th Ann. Conv. Philippines Sugar Tech.*, 1972, 69–73.—Areas of cane research where plant tissue culture is of value are surveyed, including: propagation where a large population of plants from a limited source (e.g. with a new hybrid) is required for large-scale testing; nutritional and environmental studies; studies with radio-isotopes; induced mutation; obtaining haploid and polyploid plants; herbicide screening and bio-assay for growth regulators; morphogenesis; and fusion of vegetative cells and transformation studies. Reference is made to the tissue culture programmes in Hawaii and the Philippines.

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Physiological research approach to understanding the yield differences in sugar cane. E. L. ROSARIO. *Proc. 20th Ann. Conv. Philippines Sugar Tech.*, 1972, 74–86. Photosynthesis studies on 14 cane varieties are reported and the relevance of the results to the Philippines breeding programme discussed. It was found that plants having narrow, thick and erect leaf habits

exhibited early and rapid growth. The cane should have a stalk diameter of about 25–28 mm; large-diameter canes suffer from reduced stalk numbers with consequent reduction in yield. In order to make full use of the carbon fixation potential, suitable fertilization is necessary, and a positive correlation was found between photosynthesis and leaf N, P and K, sugar yield being highly dependent on leaf P. Narrow spacing between canes to increase the number of millable stalks is considered an easy and practical means of raising sugar yields.

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Influence of some climatic factors on growth and yield of sugar cane CAC 57-11. E. P. PACARDO. *Proc. 20th Ann. Conv. Philippines Sugar Tech.*, 1972, 87–102. Details are given of experiments to determine the effects of climate and time of year on cane growth, juice quality and yield under irrigation conditions and with application of N, P and K. The tests, in which CAC 57-11 cane was planted during each of the 12 months in a randomized block design, demonstrated significant correlation between cane growth and climatic factors but also showed that determination of the predominant factor responsible for a specific growth response was difficult. Strong correlation between the climatic effects on the cane and the cane water balance is suggested. However, conclusions are tentative since the experiments were not conducted under controlled conditions.

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Trials on sugar cane tillage and cropping concepts. III. Yield effect of different planting rates. E. S. VILLARICO and F. Y. PANOL. *Proc. 20th Ann. Conv. Philippines Sugar Tech.*, 1972, 111–119.—Trials covering the crop years 1965/66–1968/69 are described, in which three different planting rates in two furrow spacings were investigated. Results from 167 plant and 129 ratoon crops indicated that a planting rate of $2\frac{1}{4}$–3 lacsas per ha was optimum on the basis of yield and production costs, although strict seed cane selection, chemical treatment of the seed pieces and proper soil covering are necessary.

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The influence of variety, organic amendments, nitrogen fertilization and cane age on the deterioration of burnt cane. M. T. ILAGA and M. T. ROBENIOL. *Proc. 20th Ann. Conv. Philippines Sugar Tech.*, 1972, 120–130. Studies indicated that: low-sugar canes tended to lose sugar more rapidly than high-sugar canes after burning; application of high quantities of N plus organic fertilizer produced high-moisture canes which, when burnt, suffered lower weight losses initially than other canes, but the weight loss of the succulent canes eventually became higher than with the untreated canes; high rates of N application caused increased stalk size and greater surface exposure to drying, so that cane weight loss after burning appeared to increase; the level of N application coupled with variety and cane age at the time of burning caused a fall in rendement. Based on the results, it is recommended that young canes which receive heavy applications of N and organic fertilizer should be cut immediately after burning and transported to the mill on the same day to reduce sugar and cane losses.

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Economics of ratooning. F. Y. PANOL and C. N. ELEVADO. *Proc. 20th Ann. Conv. Philippines Sugar Tech.*, 1972, 131–142.—Investigations of the economics of plant and ratoon crops under Philippine conditions have shown that, although highly significant differences occurred between the yields on five farms of the Victorias Milling Co. Inc. over an 18-year period, there was also considerable variability in sugar yields from both crops, so that decisions on the type of crop should be made on a field-to-field basis and not generally for the whole farm.

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The Louisiana system for handling sugar cane. F. MINVIELLE. *Proc. 20th Ann. Conv. Philippines Sugar Tech.*, 1972, 143–152, 166–168.—Descriptions and illustrations are given of the system used in Louisiana for mechanical cane harvesting, transporting, sampling and yard handling.

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Classification of trash deduction and the effects of trashy and burnt canes on juice quality. E. B. PUYAOAN and A. R. OLIVEROS. *Proc. 20th Ann. Conv. Philippines Sugar Tech.*, 1972, 231–239.—The need to reduce the quantity of trash accompanying cane in the mills and the sugar loss represented by excessive trash are discussed and the advantages and disadvantages of cane burning examined.

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Studies on sugar cane irrigation. VI. Effect of different levels of irrigation on the growth and yield of sugar cane under various ground water tables. C. CHEN, P. D. LIU and Y. T. CHANG. *Rpt. Taiwan Sugar Expt. Sta.*, 1972, (57), 29–42.—Experiments with pot-grown autumn-planted cane showed that a high water table (0·6–1·2 m) caused better growth in the early stage and a greater stalk length than did a low table (1·4–2·0 m). With a high water table, no difference was observed in the growth rate of young canes between adequate irrigation and no irrigation, but under low table conditions adequate irrigation increased growth compared with no irrigation. Differences in surface soil moisture distribution were found as a result of different levels of irrigation with low water table, but no differences were found with high table. On the other hand, cane grown under low table conditions had a better, broader root system with up to 60% greater root weight than under high table conditions. No significant increases in yield were observed with adequate irrigation under high table conditions, whereas the cane yield under low water table conditions was increased by an average of 20% when irrigated.

Studies on sugar cane irrigation. VIII. The efficiency of irrigation in substitution for hilling-up. Y. T. CHANG, T. P. PAO and K. Y. CHANG. *Rpt. Taiwan Sugar Expt. Sta.*, 1972, (57), 43–55.—Experiments showed that while replacement of hilling-up of cane with adequate irrigation increased the number of cane stalks, the occurrence of heavy lodging as a result of typhoons would expose the cane to heavy pest and disease attacks with consequent increased number of dead stalks and hence reduced yield compared with the use of hilling-up. On the other hand, an increase in yield would be expected if no typhoon occurred. No significant difference was observed in stalk length as between the various treatments (hilling-up and no hilling-up with reduced and adequate irrigation).

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Freeing sugar cane from mosaic virus by apical meristem culture and tissue culture. L. S. LEU. *Rpt. Taiwan Sugar Expt. Sta.*, 1972, (57), 57–63.—Meristem cultivation of 3–4 mm long growing points cut from mosaic-infected cane and dipped in a special liquid medium supplemented with 25% coconut milk gave a number of setts which, in most cases, showed no symptoms of the disease after transplanting. (On the other hand, the number of varieties successfully cultured was only a fraction of those tested.) Attempts to liberate growing points from downy mildew caused by *Sclerospora sacchari* were unsuccessful.

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Bionomics of *Matsumuratettix hiroglyphicus* Matsumura, an insect vector of sugar cane white leaf disease. III. A study on the relationship between environmental factors and oviposition of *Matsumuratettix hiroglyphicus* Matsumura. S. L. YANG. *Rpt. Taiwan Sugar Expt. Sta.*, 1972, (57), 65–74.—Laboratory tests are reported to determine the effects of soil type, temperature and moisture content and host plant on oviposition of *M. hiroglyphicus*. Sand (coarse or fine) was preferred by the female adults, increase in soil moisture (beyond 10%) causing a reduction in eggs. More eggs were laid at higher temperature (35° compared with 14°C). There was no close correlation between cane variety and oviposition, although lifespan of wild female adults and number of eggs laid were considerably lower on *Saccharum spontaneum* than on hybrid cane, regardless of whether the adults were collected from a cane field or from *S. spontaneum*.

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Artificial diets for rearing *Brachmia modicella* Christoph. T. H. SU. *Rpt. Taiwan Sugar Expt. Sta.*, 1972, (57), 75–80.—A modified Haydak medium of 60% unhulled rice powder, 10% wheat flour, 10% glycerol, 10% honey and 10% dried powdered yeast was found to be the most suitable of 14 diets tested for growth of *B. modicella* larvae, recognized for many years as an excellent host for rearing *Trichogramma* spp., important egg parasites of moth borers.

Effect of zinc phosphide on rat control in sugar cane fields. P. Y. WANG. *Rpt. Taiwan Sugar Expt. Sta.*, 1972, (57), 81–94.—Tests showed that 1% zinc phosphide applied at the rate of 1 kg per ha generally caused 80–100% mortality (with an average of 1½–2 days between bait acceptance and death) and was equally effective with all three species of rats (*Rattus norvegicus*, *R. losea* and *Bandicota nemorivaga*). It gave better results and was less expensive than "Warfarin", but best field control was obtained with use of both types of raw bait after pre-baiting with unpoisoned rice. Zinc phosphide was also found to be less toxic to domestic animals and more acceptable to rats than were the other rodenticides.

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Results obtained with a programme of sampling and analysis of soil carried out in the Central Portuguesa (Venezuela) zone of influence. G. SEGURA L. *Azúcar y Productividad*, 1973, (7), 10–13.—An account is given of a programme of soil sampling and analysis for P and K in 1970 and 1971, which reached down to individual supplying farms, the soils being classified in respect of their response to added fertilizer: low where an economical response was obtained in more than 80% of cases, medium where it was obtained in 50% and high for economical response in less than 10% of cases.

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Evapotranspiration and winds: study of the critical situations in Ureña. J. M. OCHOA P. *Azúcar y Productividad*, 1973, (7), 20–30.—In July and August in certain areas of Venezuela, strong winds of up to 60 kph raise the evapotranspiration rate above that at which water may be brought to the stomata through the plant from the roots and the soil. The stomata close and the cane can be scorched, especially if under strong sunlight, even though the soil may be flooded. The mathematics of evapotranspiration and water supply and albedo are discussed.

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Construction of contour structures—implements, costs and procedure. ANON. *S. African Sugar J.*, 1973, **57**, 385–391.—Trials were carried out on medium to light soils using a disc plough, a reversible mouldboard plough and a heavy-duty grader blade to construct retention-type and entrenched-type broad-based terraces on slopes of varying gradients. An improved bench terrace was also constructed with the heavy-duty grader on slopes of 20–45%. After demonstrating that structurally sound conservation terraces can be efficiently and economically constructed with conventional tractor-mounted implements, the article outlines construction procedures for each type of terrace which have been found most suitable with the three types of implements mentioned above.

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How to reduce frost damage. R. P. HUMBERT. *World Farming*, 1973, **15**, (9), 8–9, 26.—The damage caused to sugar cane by frost is described and a classification

system explained in which the cane is placed, after a frost, in one of four categories according to extent of damage for purposes of establishing when the cane should be harvested (Category IV is cane which is undamaged and can be harvested after all the frosted cane has been processed). The adverse effect of frost on cane is illustrated by weekly cane sugar contents in 1970/71 at Los Mochis, Mexico, where losses of 6·5 kg per ton of cane resulted from frost damage in early 1971, compared with the average curve for the period 1960–70. High acidity of cane juice is used as an "index of urgency" since it indicates a greatly reduced sugar recovery. The question of frost-tolerant varieties is briefly discussed as is the possibility of reducing frost damage by expanding planting in frost-free zones and harvesting cane early, before or shortly after the lowest minimum temperatures.

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Land preparation and cane varieties in the Caribbean. T. CHINLOY. *Sugar News* (Philippines), 1973, **49**, 128–133.—Land preparation as carried out in the Caribbean is described and yields per acre for 1st ratoons obtained on four Jamaican plantations are tabulated. Cane breeding in the area is discussed and some of the varieties grown are indicated, from which it is seen that only one of the B series is grown in more than one country. The present trends are contrasted with the situation in the 1930's and since.

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Nitrogen and sugar cane. II. Influence of organic and inorganic nitrogen on yield and juice quality. U. S. SINGH and L. SINGH. *Indian Sugar*, 1973, **23**, 201–204.—While all forms of organic nitrogenous fertilizers increased cane yield in tests (compared with the untreated control), they proved less effective than ammonium sulphate, which however had more adverse effect on cane sugar content and juice pol than did the others. Nevertheless, ammonium sulphate still gave the maximum sugar yield per ha.

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Aerial application of insecticides to control the sugar cane *Pyrilla* in South Gujarat. A. H. SHAH, V. J. VORA and K. P. GODHANIA. *Indian Sugar*, 1973, **23**, 205–206. Aerial spraying of cane fields with 20% "Endrin" (1250 ml per ha) gave best control of *Pyrilla perpusilla*, the population of which was reduced by 95·64% after 72 hr and by 98·21% after 18 days. The results were compared with those obtained by using 100% "Dimecron" (250 and 300 ml per ha) and 40% "Nuvacron" (1250 ml per ha) as well as the untreated control.

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Borer injury to the 1972 Louisiana sugar cane crop. L. J. CHARPENTIER. *Sugar Bull.*, 1973, **51**, (22), 22–23. A survey comprising two examinations of 100 stalks (twenty 5-stalk samples) from each of 21 representative sugar factories in Louisiana showed that borer infestation was 8%, which is considered light for the state, the average for the 10-year period 1962–1971 being 12%.

Study on the mechanical harvesting of sugar cane in Taiwan. F. M. LU. *Rpt. Taiwan Sugar Expt. Sta.*, 1973, (59), 1–13.—In field tests to compare the performances of the Toft "CH 364 Robot" self-propelled and the Don Mizzi 740 side-mounted chopper harvesters, the former proved superior in harvesting rates at all three row lengths (100, 200 and 300 m), introduced less trash with the cane and left less cane in the field than did the side-mounted machine. There was no significant difference in the performance of each machine between harvesting with the direction of cane lodging or against it.

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Criteria for predicting silicate slag demand for sugar cane. J. J. SHIUE. *Rpt. Taiwan Sugar Expt. Sta.*, 1973, (59), 15–24.—Data from tests with 15 different kinds of silicate slag conducted in Taiwan cane fields since 1961 were used to plot a graph of the relationship between probable profitable increase in cane yield and soil soluble SiO_2 content. It was concluded from this curve that when the soluble SiO_2 content was below 80 ppm, the probability of profitable increase in yield through application of silicate slag was at least 50%. The silicate slag effect was divided into four sections: (1) a significant increase in cane yield when the soluble SiO_2 content in the soil was below 46 ppm, (2) influence of environmental factors on the silicate slag at 46–80 ppm soluble SiO_2 in soil, (3) no profitable increase in cane yield when soil soluble SiO_2 was 80–150 ppm, and (4) when it exceeded 150 ppm. The soil soluble SiO_2 content should be maintained at 150 ppm. Neutralization of the soil acidity with silicate slag and the content of soluble silicate in the slag should be considered.

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Annual evaluation tests of new chemical herbicides for weed control in sugar cane in Taiwan since 1963. S. Y. PENG, W. B. SZE and H. J. YEH. *Rpt. Taiwan Sugar Expt. Sta.*, 1973, (59), 37–69.—Details are given of weed control tests for the seasons from 1964/65 to 1972/73 inclusive, showing cane germination %, stalk growth % and cane yield as well as phytotoxicity, rates of application of the herbicides and weed cover. Of the 61 products mentioned, the phenyl ureas and "Triazine" group have proved most effective as pre-emergence herbicides with autumn-planted cane, while "Gramoxone" ("Paraquat") was the most effective in post-emergence application.

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The type and origin of mica mineral in Taiwan sugar cane soils. T. C. JUANG. *Rpt. Taiwan Sugar Expt. Sta.*, 1973, (59), 71–80.—Studies of 11 clay soil samples containing particles smaller than 2μ and representing four soil groups found in Taiwan cane fields are reported in which the minerals in the clay fraction were identified by X-ray diffraction, heat treatment and ethylene glycol retention and the fraction containing particles smaller than 0·2μ further separated by centrifuging. The mica in this fraction

was purified by differential dissolution analysis and hot HCl treatment. The type and origin of the mica are indicated.

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Effect of planting method and harvest time on the control of root size of processing sweet potato intercropped with sugar cane. K. H. KWONG and J. B. CHEN. *Rpt. Taiwan Sugar Expt. Sta.*, 1973, (59), 81–96.—Results of tests to determine the effects of various factors on the yield of sweet potato grown as cane intercrop are reported. Increased density of planting did not affect cane yield.

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Chemical control of creeping millet grass in sugar cane. W. B. SZE. *Rpt. Taiwan Sugar Expt. Sta.*, 1973, (59), 97–107.—Tests showed that only 6 kg a.i. of "Dalapon" plus 4 kg a.i. of 2,4-D per ha applied one month after planting had any appreciable effect on this tenacious weed (71·5% reduction of the rhizomes) without having any toxic effect on cane. "Terbacil", "Bromacil", "Diuron" and"Linuron" had greater effects on the weed but were also highly toxic to cane, and even repeated applications did not completely eradicate the weed.

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The insect borer—*Eldana saccharina* Walker. A. J. M. CARNEGIE. *S. African Sugar J.*, 1973, **57**, 445–447. The infestation of young ratoons by *E. saccharina* in Swaziland and of standover cane in Natal is reported and the history of the pest in Africa briefly recounted. The borer is described and details given of its life cycle as well as possible control measures. While the silken cocoon containing the pupa is difficult for parasites to penetrate, the egg and larva are vulnerable to ants. Careful use of insecticides is therefore advocated in order to avoid killing ants; persistent, broad-spectrum chemicals are not recommended, although application of a non-persistent insecticide such as "Endosulfan" along the cut rows of cane before soil is heaped over them will help destroy residual borers. However, most of the borers will be eliminated by strict field hygiene which will prevent borers and moths emerging above ground. This includes avoiding having standover cane, cutting at or below ground level to leave a minimum of stubble, removing or destroying all residual sticks and tops and covering any exposed stubble with soil.

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South Africa urged to introduce mechanical harvesting. B. DINGLEY. *S. African Sugar J.*, 1973, **57**, 453–455. The author describes mechanical harvesting, planting, cultivation and weed control methods and machines used in Australia and discusses the advantages of containerized cane transport while also describing the benefits of the tramline system for short hauls. While advocating the introduction of mechanical harvesting on a commercial (as opposed to experimental) basis in South Africa, the author briefly indicates a number of problems which need to be solved, including modification of factory yards and transport systems.

Wider cane rows—two cane drills. L. L. LAUDEN. *Sugar Bull.*, 1973, **51**, (23), 4.—Reference is made to experiments conducted by R. J. MATHERNE[1] in which he demonstrated the greater yields of cane obtainable by reducing the inter-row width to 3 ft as opposed to 6 ft. However, it is pointed out that such a small inter-row distance would not be practical because of the difficulty of finding sufficient soil to cover the cane at planting time and of cultivating the rows, besides the need to modify harvesters to cut two narrow rows at a time; moreover, the large tyres in the narrow space between the rows would push the cane drills together and damage the stubble. However, the experiments have indicated two possibilities of increasing cane stalk density per acre, viz. using two drills 30 inches apart on top of rows 7 ft apart or on top of rows 7½ ft apart. Both methods are being tested. Planting is facilitated and, according to a representative of a cane harvester manufacturer, harvesters can be modified to suit requirements. Conventional equipment can be used for cultivation. A number of cane farmers have shown interest in the system which, theoretically, should reduce the amount of seed cane required.

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Results of sugar cane variety outfield experiments in Louisiana during 1972. M. J. GIAMALVA. *Sugar Bull.*, 1973, **51**, (23), 6–8.—Results are given of varietal trials (up to 2nd ratoons) on light and heavy soil conducted under normal plantation practices at 13 different locations. Outstanding yields were obtained with CP 65-357 and CP 61-37 on both soils, while CP 67-411 performed well as plant cane.

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Sugar cane crossing programme at Canal Point, 1972-73. N. I. JAMES and J. D. MILLER. *Sugar Bull.*, 1973, **51**, (23), 10–13.—Details are given of aspects of the breeding programme, including selection of breeding clones, photoperiod research, seed production and distribution, and plans for the 1973/74 crossing season.

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Drought plagues sugar industry. P. ESLEYER. *Sugarland* (Philippines), 1973, **10**, (4), 8, 17–18.—The effects of drought on sugar cane, as experienced in a number of countries including the Philippines, are discussed and explanations given regarding causes of drought and factors which aggravate the situation. The use of irrigation as an insurance against drought is briefly mentioned.

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Investigation on the cutters of cane combines. M. PASCUAL. *ATAC*, 1973, **32**, (3), 29–33.—A description is given of an experimental rig used for design studies to improve the performance of the knives used in cane harvesters. An indication is given of the theory behind such design studies.

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[1] *I.S.J.*, 1973, **75**, 15.

Sugar beet agriculture

The beet—sacchariferous plant. J. CHRISTMANN. *Hautes Etudes Betterav. Agric.*, 1973, **5**, (21), 7–16. The origin and development of the sugar beet from its wild ancestor are discussed and the anatomy and root development of the sugar beet described, as is saccharogenesis within the plant.

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Beet cultivation in the USA. X. DUCHENE. *Hautes Etudes Betterav. Agric.*, 1973, **5**, (21), 17–24.—An illustrated account is given of observations in regard to cultural practices and agricultural research, as well as sugar factory operation, during a joint meeting of the IIRB and ASSBT in June 1973.

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Beet seed treatment tests. V. D'AMBRA and S. MUTTO. *Ind. Sacc. Ital.*, 1973, **66**, 103–106.—Trials are reported on the action of a range of 19 chemicals and mixtures in the prevention of pre-emergence and post-emergence damping-off in beet caused by *Pythium* sp., *Rhizoctonia solani* and *Phoma betae*. Some were effective for 12 months after the seed treatment and none affected germination.

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Effect of various types of organic fertilizer on the sugar beet yield in continuous tests carried out over a number of years. G. BACHTHALER. *Zucker*, 1973, **26**, 598–604.—Details are given of tests carried out during 1947–1969 to determine the effects of various forms of organic fertilizer (humus, beet leaves and green manure, straw and green manure, farmyard manure and compost from domestic refuse and from sewage sludge) on beet yield and sugar content. Results, given in tabulated form, indicate that the effects of the fertilizers depended on soil and climatic conditions.

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The problem of wild beets. L. VAN STEYVOORT and R. VANSTALLEN. *Publ. Trimest. Inst. Belge Amél. Betterave*, 1973, (3), 87–109.—A survey is made of the existence, origin and possible control measures for the problem of wild beet in sugar beet fields in Belgium, which has recently come to the fore. No solutions are proposed and it is concluded that the problem will require the collaboration of plant breeders, agronomists, research chemists, plant physiologists and mechanical designers in order to achieve its elimination.

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Handle beets carefully at harvest. P. B. BRIMHALL. *Sugar Beet J.*, 1973, **37**, (1), 3–4.—The losses and damage caused to beets by physical injury after harvesting and as a result of respiration in the presence of dirt, leaves and trash in piles, are explained and the need to avoid such damage and losses emphasized.

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Soil test this fall. L. S. ROBERTSON. *Sugar Beet J.*, 1973, **37**, (1), 4–6.—Facilities are available to beet farmers in Michigan to have their soils examined, and the requirements of the farmer in sampling and sample preparation are described. By making proper use of the analyses reported, fertilizer applications can be calculated for maximum sugar yield per acre.

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Canopy coverings. R. A. FOGG. *Sugar Beet J.*, 1973, **37**, (1), 6–7.—Canopies are plastic sheets used to cover stored beet piles and are supported by a network of trusses and cross-braces so as to maintain an air space above the beets. They permit circulation of air for cooling and protection from inclement weather.

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Watch for bad soil structure. L. S. ROBERTSON and E. A. ERICKSON. *Sugar Beet J.*, 1973, **37**, (1), 8–9. Poor soil structure gives rise to malformed sugar beets and an illustrated account is given of such soils and their treatment, particularly by improved drainage.

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Controlling weeds throughout your crop rotation. F. B. RUSSELL. *Sugar Beet J.*, 1973, **37**, (1), 10.—Annual weeds in beet fields may be controlled by chemicals and good cultivation practices, but with perennial weeds, chemical control throughout the crop rotation must be used. A new herbicide, "Round-up" ("Glyphosate") has shown excellent results with Canadian thistle and other perennial weeds but is not yet commercially available. Thus, present treatment involves the use of 2,4-D either alone or with "Dicanba" ("Danvel-D") for this weed and "Dalapon" for control of quack grass.

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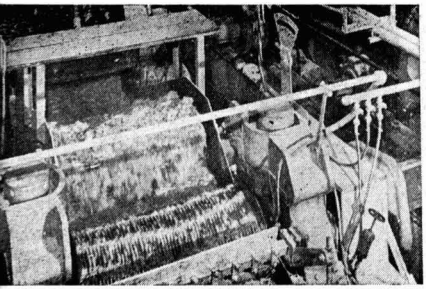
Level of yield, plant population and choice of crop method in modern sugar beet agriculture. C. WINNER. *Zucker*, 1973, **26**, 637–643.—Beet yield and quality as a function of local environmental factors are discussed, with particular attention to the relationship between yield, plant population and spacing. Since conditions vary from year to year, only the average from a number of years can be used as criterion for the optimum crop method, i.e. planting to stand or with manual thinning. The effects of gaps or excessively thick stands on yield are examined, as are various deviations from the optimum plant population and spacing.



Cane sugar manufacture

Some ecological effects of discharged sugar mill wastes on marine life along the Hamakua Coast, Hawaii. R. W. GRIGG. *Rpts.* 1972 *Meeting Hawaiian Sugar Tech.*, 81–95.—Results are published of a study, made by two firms representing several Hawaiian sugar manufacturers, designed to evaluate the effect of cane sugar factory wastes on the marine environment. No significant changes in temperature salinity or oxygen concentration were found in the waters adjacent to the factories, although noticeable deposits of sediment and bagasse were found, trash from one factory being located at a depth of 340 m. Coral and associated organisms covered by sediment in shallow water began to recover soon after sediment discharge stopped, but more time was required for recovery in deeper water. *Pocillopera meandrina* is particularly sensitive to sediment and is therefore considered as a suitable guide to the extent of pollution of an area by sugar factory waste. Changes in species and abundance of near-shore fishes have been observed, and decline in landings of one particular fish is attributed by fishermen to a combination of factory waste and over-fishing, although the major changes occurred shortly after the introduction of mechanical harvesting.

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Preventive maintenance of electrical installations in the sugar industry. M. L. AGIWAL. *Sugar News* (India), 1973, **5,** (1), 35–39.—Causes of motor overheating and ways of avoiding this are discussed and preventive maintenance worksheets for daily checking of motors and analysing breakdowns are reproduced.

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Glades Sugar House expands. E. R. ARIAS. *Sugar J.*, 1973, **36,** (2),'21.—Details are given of the expansion programme being undertaken to expand the daily crushing capacity of this cane sugar factory to 15,000 t.c.d. Completion of the programme is timed for November 1975.

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Recycling or reclamation. D. BEVAN. *Producers' Rev.*, 1973, **63,** (7), 41–47.—See *I.S.J.*, 1974, **76,** 116.

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Studies on the De Smet cane diffuser in India. S. MUKHERJEE *et al. Indian Sugar*, 1973, **23,** 25–42.—See *I.S.J.*, 1974, **76,** 52.

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Commentary on the oxidation lagoon. L. D. AZUAJE. *Azúcar y Productividad*, 1973, (7), 14–19.—Pollution of the Manzanres river arose largely from the discharge into it of 150 litres.sec^{-1} of wastes from Central Cumanacoa; this was stopped and disposal attempted by its use as irrigation liquid. The temperature was too high for successful application and a lagoon was therefore built with four aerators to reduce the BOD to less than 250 from an original value of up to 8000 mg.litre^{-1}.

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An economic installation of evaporators for a modern sugar factory. S. P. MISHRA. *Indian Sugar*, 1973, **23,** 113–128, 187–200.—A quintiple-effect evaporator made up of bodies having 12,000, 7000, 7000 (two parallel identical bodies), 5500 and 3500 ft^2 heating surface at Warana sugar factory (of 100 t.c.h. crushing capacity) failed to achieve the rated capacity and used excessive amounts of steam, causing considerable financial loss. Causes of the difficulties are discussed in detail, including: inadequate condensing capacity in the 4th and 5th effects, causing juice distribution problems in the parallel 3rd effects; a disproportionately large 1st effect which led to poor juice circulation and choking of tubes with juice; inadequate condensate removal and flash heat utilization, causing high steam losses and reduced evaporation in the 2nd effect. Remedies carried out for the subsequent season included using the 1st effect as a vapour cell with the other effects forming a quadruple-effect evaporator, and installation of forced circulation in the 1st and 2nd effects. The capacity was thus raised by some 25% and the fuel comsumption reduced to a record minimum. Performance of the individual effects is discussed and further modifications advocated which would be suitable for a factory having a crushing capacity of 200 t.c.h.

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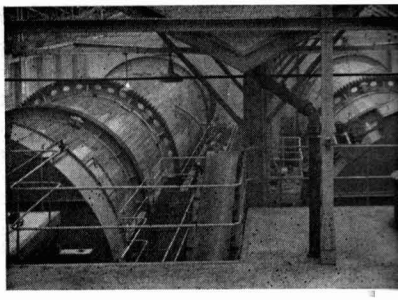
Observations on the performance of continuous centrifugals at Sakthi Sugars Ltd. T. T. OOMMEN and K. K. MENON. *Sugar News* (India), 1973, **5,** (2), 33–34. "Konti 8/30°" continuous centrifugals and batch machines, both supplied by Walchandnagar Industries Ltd., are used for curing *C*-massecuite at the authors' factory, permitting comparison of their performances. Final molasses purity is sometimes slightly higher and sometimes slightly lower from the continuous machines. Capacity is about the same but lower curing quality in the massecuite reduces capacity more in the batch than the continuous machines. Breakage of sugar crystals has been higher with the latter but this has not been of disadvantage when they are used for seed magma. The biggest disadvantage is the need to use imported pure nickel screens which are subject to damage and have a rather short life.

Beet sugar manufacture



New clarifier-thickener installed at Fort Garry factory. K. M. Foo, M. Rychkin and R. A. McGinnis. *Sugar J.*, 1973, **36,** (3), 28–30.—Details are given of the Enviro-Clear clarifier system at the Fort Garry, Winnipeg, factory of The Manitoba Sugar Co. Ltd. which is used to treat the underflow from a Dorr clarifier handling the beet flume and wash water. The new system increases the underflow solids content from 2–6% to 30–40%, the mud being transferred at the rate of 40 gal.min^{-1} to sloping drainage piles of 4·8 acres. Operating costs of the thickening and disposal system are about ¼ of those of excavating the settling ponds used for the mud from the Dorr clarifier.

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Tests on FD-150M disc filters for thick juice filtration. G. A. Dudchenko, S. K. Loktev, V. A. Zambrovskii and Yu. V. Anikeev. *Sakhar. Prom.*, 1973, (9), 10–13. Tests are reported in which the performance of a Soviet-built FD-150 M disc filter with a nozzle system for sweetening-off (found in earlier tests to be of inadequate efficiency) was compared with that of the same filter but provided with a different nozzle system. A number of recommendations are made on the basis of the tests.

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Performance of the scheme with pre-carbonatation mud removal. G. A. Vovk and M. I. Daishev. *Sakhar. Prom.*, 1973, (9), 13–15.—Comparison of the performance in 1972 of the carbonatation station at Timashevskii, where main liming is preceded by two-stage pre-carbonatation and removal of the pre-carbonatation mud, with the results obtained in 1969 (chosen as the best year regarding beet quality) using a BMA scheme showed that purity rise from raw to 2nd carbonatation juice averaged 0·9 units higher in 1972 than in 1969, while 2nd carbonatation juice, thick juice and white sugar colour was lower in 1972, as was molasses purity, although molasses yield and juice lime salts content were higher in 1972. Comparison with 1966 values, where beet quality was about the same as in 1972, showed even greater improvements with the new system.

* * *

Electric treatment of plant raw material before juice extraction. A. Ya. Papchenko. *Sakhar. Prom.*, 1973, (9), 21–23.—Laboratory tests are briefly reported in which 100 g of beet cossettes immersed in water or juice at 50°C were subjected to electric current at 40 kV passing across the cell between two electrodes. Results showed that the diffusion rate was greater than without electric treatment.

Growing algae at sugar industry and starch syrup undertakings. V. N. Yuzvenko. *Sakhar. Prom.*, 1973, (9), 35–37.—Equations are presented for calculation of various factors involved in effluent treatment with algae.

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Automatic control of a 1st product massecuite mixer slide valve. K. A. Klim. *Sakhar. Prom.*, 1973, (9), 45.—Brief information is given on a system for automatic control of a massecuite mixer slide valve as a function of required massecuite level in the distribution trough.

* * *

Semi-automatic unit for grinding and sharpening beet slicer knives. V. A. Balyura and M. Ya. Orlova. *Sakhar. Prom.*, 1973, (9), 46–47.—The process used to prepare and grind beet slicer knives of the Königsfeld type at the authors' sugar factory is described and results obtained from use of the treated knives indicated.

* * *

Treatment of beet (sugar) factory waste water by the activated sludge process (biosorption process). M. Nogai. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1973, **24,** 25–35.—Details are given of the treatment used at Honbetsu where the outside temperature can fall as low as —28°C. Waste water temperature did not fall to this level, however, and the activated sludge process was effective. The installation handled a daily 17,000 m^3 of waste water, eliminating 4250 kg BOD_5 per day. The sludge recycle ratio was more than 70% and minimum elimination of BOD_5 was attained at 13°C. The excess sludge and final sludge were collected in a pond and decomposed by digestion during the summer.

* * *

Some considerations on beet yard management at a sugar factory. H. Brunke. *Ind. Alim. Agric.*, 1973, **90,** 881–884.—The problem of excessive quantities of dirt accompanying beet from the field is discussed and information given on trends in beet storage in European countries and the beet yard equipment used to unload, pile and clean the beet.

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Some aspects of sugar factory control. M. Cottrelle. *Ind. Alim. Agric.*, 1973, **90,** 889–893.—Control schemes for milk-of-lime preparation, pre- and main liming, carbonatation and 1st carbonatation mud vacuum filtration which have been in operation for a number of campaigns at sugar factories are described to demonstrate how equipment already available in

factories can be interlinked to provide complete automatic schemes rather than merely for individual steps or parameters.

* * *

Ion exchange resins in the sugar industry. D. HERVÉ. *Ind. Alim. Agric.*, 1973, **90**, 897–909.—Among uses of resins surveyed are: juice deliming, juice and run-off demineralization, syrup and remelt liquor decolorization and liquid sugar manufacture. Processes within each group are described and typical performance data presented.

* * *

Diffusion equipment in the sugar industry. New developments. M. ROCHE. *Ind. Alim. Agric.*, 1973, **90**, 913–916.—Descriptions are given of the RT4 and De Smet beet diffusers with some information on their histories of development.

* * *

Recent developments in the protection of raw juices in the sugar industry. B. GUÉRIN, M. DEFRENNE, M. VELINGS and F. VERMEULEN. *Ind. Alim. Agric.*, 1973, **90**, 919–925.—Tests are reported which showed that addition of 0·4–0·5 ppm of "Septosol I 31", a bacteriostatic agent containing 70% by weight of iodoacetone, at regular invervals (depending on type of diffuser) prevented increase in the bacterial populations and was as effective as large quantities of formalin. Two schemes for adding "Septosol I 31" are briefly described.

* * *

Survey of 1st carbonatation (juice) filtration in the sugar industry. Calculation of plant parameters. G. GAUDFRIN and E. SABATIER. *Ind. Alim. Agric.*, 1973, **90**, 927–938.—Various methods used to thicken and filter 1st carbonatation juice are surveyed and brief descriptions given of the Gaudfrin continuous vertical plate pressure filter and the Putsch rotary pressure filter. The difficulties of filtering 1st carbonatation juice are discussed and calculations made of filter throughput according to type of filter and as a function of the length of cycle and pressure. Calculation of the parameters of a complete filter station is illustrated by two examples, one referring to the use of universal filters alone and the other relating to the use of batch filter-thickeners followed by rotary vacuum filters. The effect of filter aid and the problem of clogging (divided into "mechanical" clogging caused by the juice fines, and "chemical" clogging caused by CO_2 in the juice) are examined.

* * *

Can corrosion in evaporation now be detected and halted? P. DEVILLERS, C. CORNET and R. DETAVERNIER. *Ind. Alim. Agric.*, 1973, **90**, 943–951.—Measurement of iron in juice by the method of PIECK & HOUSSIAU[1] has been used with success for measuring the corrosion occurring during passage of juice through an evaporator. Examples of graphs of iron in juice entering the evaporator and leaving the 2nd and last effects are provided for a number of the 16 factories where the analyses were made, together with their interpretations. Sudden increases in iron content indicate corrosion, and their occurrence in specific juices located the effect where it was taking place. Further, determination of iron contents gives a measure of the amount of iron lost to the juice by corrosion and so the state of the effect at the end of the campaign. It was found that corrosion could be halted by addition of NaOH to raise the pH to 11 (which rendered the metal surface passive); corrosion did not recur until the pH in the evaporator had returned to its original 9·2. During the treatment, sulphitation of the syrup to pH 10 prevented serious difficulties in crystallization.

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Low-grade crystallizer work in the sugar factory. J. GENOTELLE. *Ind. Alim. Agric.*, 1973, **90**, 953–958. Two practices used in some French sugar factories are described: the first involves pre-centrifugalling a part of the low-grade massecuite and returning the molasses separated to the remainder. This permits greater exhaustion of the molasses since the diluted massecuite is easier to handle. The second practice is the use of large closed crystallizers having a vertical shaft carrying stirring arms and fixed heat exchange elements between these arms. Such crystallizers are easily erected and cost less than the classical type.

* * *

The continuous saccharate plant at Origny Ste.-Benoite. C. OF and P. CREDOZ. *Ind. Alim. Agric.*, 1973, **90**, 961–968.—An illustrated account is given of the RT saccharate process and plant installed by Fives Lille-Cail at this French factory in 1972. The molasses is reacted with quicklime in the cold to yield a calcium saccharate precipitate which is recycled to preliming and first liming; the sucrose lost in the effluent is only 7% of the molasses sugar. Details are given of process conditions, lime, heat and water balance, etc.

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Formation of a continuous non-Newtonian fluid stream during pneumoplastic transfer. H. DABROWSKI. *Gaz. Cukr.*, 1973, **81**, 257–260.—Investigations of the rheological properties of carbonatation mud showed that they approximated to the properties of an ideal plastic liquid after preliminary maceration and within a temperature range of 30–80°C. The results were used as a basis for a method of transferring undiluted carbonatation mud by means of compressed air; the device used to form a continuous mud stream, including a variable orifice, is briefly described. The so-called "pneumoplastic" method permits mud of 30–60% dry solids to be transferred over considerable distances.

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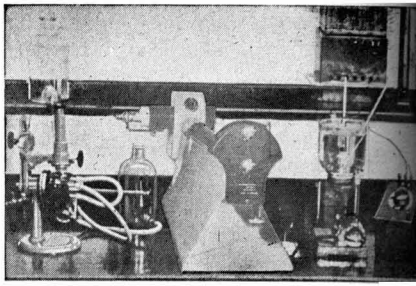
Modern centrifugal motors for the sugar industry. H. G. HALT and H. PÖTSCHKE. *Zeitsch. Zuckerind.*, 1973, **98**, 615–617.—Descriptions are given of Hinz pole-change, three-phase squirrel-cage induction motors especially developed for use in sugar centrifugals where the requirement is for acceleration and deceleration of large masses.

[1] *I.S.J.*, 1972, **74**, 116.

Laboratory methods & Chemical reports



Arsenic contents of juice and bagasse from sugar cane treated with organo-arsenic compounds. R. P. COSSIO. *Rev. Ind. Agric. Tucumán*, 1972, **49**, (2), 51–57.—Juice and bagasse from cane treated with 5·2 and 3·0 kg/ha of disodium methanearsonate herbicide (63% commercial product) were analysed at monthly intervals over a 7-month period for arsenic. The arsenic contents fell with time in both juice and bagasse and after 5 months were 0·048 and 0·040 ppm in the juice (at the higher and lower doses, respectively) and 0·145 ppm in the bagasse (at both doses). These are regarded as normal limits, and it is considered inadvisable to apply arsenical herbicides later than 5 months before harvesting.

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Determination of non-nitrogenous organic acids in sugar factory products. N. A. HASHMEY. *Listy Cukr.*, 1973, **89**, 208–211.—A survey of methods for determining non-nitrogenous organic acids, particularly lactic acid, is presented with 42 references to the literature.

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An equation for the relationship between sucrose solubility and temperature. J. ŘÁDEK and V. VALTER. *Listy Cukr.*, 1973, **89**, 214–215.—The authors consider it preferable to express sugar solution concentration by the Herzfeld number ($H = 0{\cdot}3423\ c$, where c = molality in kmole per kg water) than by °Brix. The relationship between sucrose solubility and temperature is described by a polynomial equation, and substitution of values for the coefficients calculated by equations developed by VAVRINECZ and VAŠÁTKO *et al.* gives solubility values at 70°, 75° and 80°C which are in close agreement with experimental values. The equation takes the form $H^{-1} = 3{\cdot}76 \times 10^{-3}(152 - t)$, where t = temperature.

* * *

Determination with EDTA of lead in lead acetate-based reagents and in products used for their preparation. G. RENS. *Sucr. Belge*, 1973, **92**, 311–336.—Details are given of a method for determining lead by titrating with EDTA. At relatively high lead contents pH has little effect on titration, and Ca^{++} and Mg^{++} ions, present for instance where hard water is used for dilution of the reagent, do not interfere. (Because of marked precipitation of lead when hard water is used for dilution, the water should not be too hard.) At high dilution of the lead solution, hexamethylene tetramine must be added to adjust the pH to 5·6, but it does not affect the results at high lead contents. Proportionality was tested and found to be excellent.

Habit modifications of sucrose crystals. G. MANTOVANI, C. A. ACCORSI and G. VACCARI. *Zucker*, 1973, **26**, 513–518.—See *I.S.J.*, 1974, **76**, 186.

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A method for determining the proportion of broken particles in ion exchange resins. F. PERSCHAK. *Zucker*, 1973, **26**, 519–520.—A smooth-surface runnel 151 cm long and 16 cm wide having an adjustable angle of slope (15° is optimum) is used in the method described. The resin is first dried under vacuum at 50°C for 72 hr (after washing to remove chemicals where necessary) and then emptied into a powder bottle. After careful shaking, a 0·2–0·5 g portion is separated from the contents and divided into a number of lots which are placed at the upper end of the runnel. Whole beads of resin roll down and are collected and weighed, while the broken particles are brushed from the runnel into a collector and also weighed. Standard deviation from the mean in tests with 20 individual samples taken from different zones in a column was $\pm$ 4·93%.

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Study on the automation of sugar analysis. III. Automated determination of reducing sugar in cane sugar. W. C. CHENG and H. I. SHIN. *Rpt. Taiwan Sugar Expt. Sta.*, 1973, (59), 25–35.—Automatic determination of reducing sugar with the Technicon "AutoAnalyzer" using picric acid gave results of excellent accuracy and reproducibility in white and raw sugar tests and was found reliable for use with high concentrations of sugar solution. Preparation requires only dissolution of the sugar and passage of the solution through filter paper without the need for further clarification. While giving more accurate results than the OFNER method with white sugar, the method gave values comparable to those of the LUFF-SCHOORL method, but was more rapid and reliable.

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Determination of sodium and potassium in the tissues of maize and sugar beet by means of ion-specific electrodes. E. CHAMBERLAND and E. B. DOIRON. *Canad. J. Plant Sci.*, 1973, **53**, (1), 233–234; through *Anal. Abs.*, 1973, **25**, Abs. 2645.—The dried and ground sample (20–40 mesh) is extracted with 40 ml of 0·1M Mg acetate (at approx. pH 7·0) by shaking for 15 min. The Na^+ and K^+ in the filtered extract are measured with a Corning NAS 11-18 glass electrode and an Orion 92-19 ion-exchange electrode, respectively. To prevent interference by K^+ in the determination of Na^+ (and vice versa), the K standards contain 100 ppm of Na, and the Na standards 100 ppm of K. The Na and K contents are read from calibra-

tion graphs on semi-logarithmic paper or on a potentiometer with a logarithmic scale. For maize leaves and sugar beet petioles, results agree closely with those obtained by atomic absorption spectrophotometry.

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Simplified calculation of crystallization schemes in beet sugar manufacture. I. N. KAGANOV and A. A. SLAVYANSKII. *Sakhar. Prom.*, 1973, (9), 15–19.—A system is described for calculation of dry solids and water in boiling house products from thick juice to white sugar.

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Dependence of sucrose solubility on pH and temperature of the medium. S. E. KHARIN, S. Z. IVANOV and I. P. OROBINSKII. *Sakhar. Prom.*, 1973, (9), 19–21.—Equations are presented for calculation of sucrose solubility in terms of 1st and 2nd stage dissociation and of sucrose solution density as a function of degree of hydration. Density values are tabulated for temperatures in the range 20–80°C, while solubility values are given for the same temperature range for pH in the range 8–10.

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Calculation of the light filter correction factor for determining sugar colour according to GOST 12572-67. S. KH. SHEREMET'EV. *Sakhar. Prom.*, 1973, (9), 27–29. An equation is presented for calculation of the correction factor to be applied to light filters to adjust the spectral distribution function to the mean value for white sugar. Tabulated values of optical density, light penetration factor and a complex function allowing for daylight sensitivity of the eye and light energy distribution are given for the wavelength range 400–740 nm.

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Thermal conduction of sugar. M. A. GROMOV. *Sakhar. Prom.*, 1973, (9), 32–35.—The relationship between thermal conduction of sugar and its porosity, temperature and moisture content is examined and comparison made between experimental and calculated values of thermal conduction. While density and moisture content exert considerable effect on thermal conduction, temperature has a negligible effect.

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Microbiology of crystal sugar. P. BIDAN and F. HEITZ. *Ind. Alim. Agric.*, 1973, **90**, 867–877.—The chief micro-organisms found in white sugar and the conditions under which they develop are discussed and high-risk areas of contamination from mother-liquors and air considered, including centrifugals and conveyors. The increase in specific and total micro-organisms from thick juice leaving the evaporator to bagged sugar is tabulated, and it is shown that drying helps to reduce the bacterial populations. Amongst methods for combating bacterial infection are listed physical means (high temperature, irradiation and syrup filtration to reduce insoluble impurities contents) and, more briefly, chemical means. Determination of bacterial counts and sampling problems are finally examined.

Determination of lubricant in Chambon pressed cube sugar. S. AKOGLU. *Seker*, 1973, **23**, (88), 40–42.—In Chambon sugar cubing machines the outer edges of the moulds are lubricated with a mixture of stearine and margarine in order to discharge the pressed cubes from the moulds to the drying plate without deforming or overturning them. Part of this mixture remains on this sugar and is present in the range 6–20 ppm; a method has been developed for measuring this amount which involves extraction with chloroform and carbon tetrachloride, evaporation and weighing the residue.

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Testing of sugar cane varieties for milling quality. L. P. HEBERT. *Sugar J.*, 1973, **36**, (4), 8–12.—The derivation of formulae for assessment of milling quality of cane is briefly discussed and the varietal correction factors for pol and Brix used for comparison of clones at the Canal Point cane breeding station are discussed. Tests have been run on a number of varieties grown in Florida for evaluation of the VCF values and their variations are examined statistically. The absence of perfect correlation between fibre content and juice extraction requires continued use of milling quality tests; while crusher juice determinations are adequate for elimination of canes of low juice content, more precise measurements, involving difficulty and specialized equipment, are necessary for reliable evaluation of milling quality.

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Studies on the adsorption of microbes by decolorizing carbons. K. HANADA and E. NINOMIYA. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1973, **24**, 12–18.—Adsorption of bacteria and yeasts on powdered and granular carbon and bone char was studied; the first was found the most effective. Adsorption by granular carbon increased as grain size decreased. All micro-organisms studied showed similar adsorption except *Escherichia coli*, and little change occurred within the pH range 3–8. When the carbon had previously been treated with sucrose or acid dyes, its adsorptive ability was reduced; in the former case this is attributed to preferential adsorption of the sucrose and in the latter by electrostatic repulsion of the negatively charged micro-organisms by the carbon on which a negative charge has been induced by adsorption of the acid dye.

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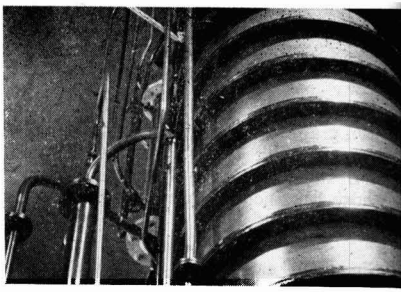
Sugars in the non-dialysable melanoidin produced from the reaction of glucose and ammonia. II. H. TSUCHIDA and M. KOMOTO. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1973, **24**, 42–49.—The fractions isolated by dialysis and the undialysable melanoidin produced by the interaction of glucose and ammonia[1] were hydrolysed and the sugars present examined using DEAE-cellulose chromatography, gas-liquid chromatography and paper partition chromatography; sugars identified included glucose, fructose and arabinose in varying amounts as well as other unidentified constituents.

[1] *I.S.J.*, 1970, **72**, 376.

By-products



Some basic physical properties of bagasse. F. P. Wu, C. T. Chen and Y. H. Chiang. *Taiwan Sugar*, 1973, **20**, 61–63.—Important basic data required for evaluation and comparison of bagasse from different sugar factories, as under Taiwan conditions, including expansion of baled bagasse, elongation of pressed bagasse, and density as a function of moisture content (shrinkage under imposed pressure) are given.

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A possible utilization of by-products of the sugar industry. S. Bose, K. C. Gupta and S. Mukherjee. *Sugar News* (India), 1973, **4**, (12), 4–8.—A survey is presented of cane by-products utilization, including paper, board and furfural manufacture from bagasse, yeast and alcohol from molasses, filter cake as fertilizer and cane wax extraction from filter cake.

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Sugar cane and its varied uses. A. K. Kadirvel and S. D. Rajan. *Sugar News* (India), 1973, **4**, (12), 16–17. Cane by-products are briefly surveyed with mention of cane trash, filter cake and molasses utilization as fertilizer, cane tops as animal fodder, bagasse and molasses (fermentation) by-products and cane wax extraction.

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Sugar cane molasses as cattle fodder. R. Sans-Soucy. *Rev. Agric. Sucr. Maurice*, 1973, **52**, 15–38. The literature on the use of cane molasses as cattle fodder is reviewed (with 46 references), brief mention also being made of incorporation of a bagasse/molasses mixture in beef cattle rations.

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Characterization of the process of manufacturing hard fibre boards from sugar cane bagasse by the wet-dry method. E. Batlle C., J. Suárez L. and N. Rodríguez T. *Sobre los derivados de la caña de azúcar*, 1973, **7**, (1), 3–12.—A study of prehydrolysis of bagasse for board manufacture under varying conditions of time and temperature indicate the optimum to be 170°C for 15–20 minutes. The yield from bagasse is 10–15% lower than with Douglas fir and it is proposed to study its improvement by means of additives, including examination of their effects on the physico-mechanical properties of the pulp and a technico-economic evaluation of the process.

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Physico-chemical properties of the black alkaline liquors from bagasse. N. L. Luna V., C. Gastón P. and Z. Montano P. *Sobre los derivados de la caña de azúcar*, 1973, **7**, (1), 13–23.—Alkaline black liquor from the pulping of bagasse may be used as a source of sodium and also has a fuel value. In order to provide design data for pilot plant and industrial scale recovery equipment, samples of liquor were concentrated to 10–50°Bx and the variations of density, specific heat and boiling point with concentration were measured. The variation of viscosity with shear rate was studied and the samples analysed are characterized as non-Newtonian thixotropic fluids.

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Proteinated molasses: preparation, characteristics and properties. A. Bell and J. L. García R. *Sobre los derivados de la caña de azúcar*, 1973, **7**, (1), 30–40.—An animal fodder having the title name is produced by mixing cane juice or syrup with yeast and concentrating to a consistency or viscosity similar to that of final molasses, e.g. 60–80% total solids. No sugar is extracted, most of the sucrose present being inverted by the enzyme action of the yeast. The nitrogen content is 1–3%, corresponding to 5–15% protein, on solids.

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Hydrolysis of bagasse. I. Hydrolysis of the hemicelluloses in static conditions. R. Blanco A., G. Alfonso N. and J. Lastra R. *Sobre los derivados de la caña de azúcar*, 1973, **7**, (1), 54–64.—The hydrolysis of bagasse with dilute (0·5%) sulphuric acid was studied under static conditions, at temperatures in the range 100–160°C. The applicability was shown of a kinetic scheme involving two simultaneous first-order reactions for the hydrolysis of hemicelluloses which assumes the presence of two easily-hydrolysed polysaccharide fractions. Conditions were determined for maximum yield of reducing substances in the hydrolysate as well as the dynamics of formation of organic acids and furfural.

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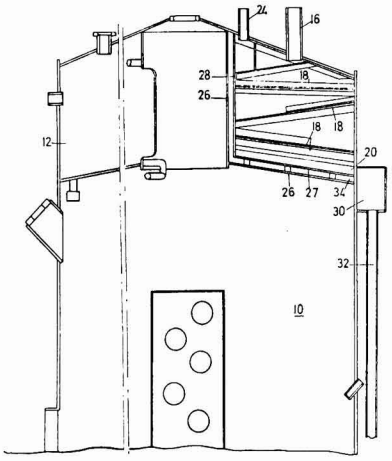
Composition of the residues from the sugar factory and distilleries. N. A. da Gloria, A. G. Santa Ana and E. Biagi. *Brasil Açuc.*, 1973, **81**, 518–527. Chemical analyses, with standard mean deviations and coefficients of variation, are tabulated for Ca, Mg, K, N, P_2O_5, SO_4, readily oxidized organic carbon and residue on drying at 40°C for samples of filter mud and three vinasse types (and also the vinasse acidity and pH) during the period of cane sugar manufacture and alcohol production in one factory-distillery. The results showed that the vinasse was too heterogeneous but that filter mud was more uniform in composition. The C:N ratio of the wastes was such that they could be used as fertilizer without additional treatment.

Patents

UNITED KINGDOM

Vacuum pan. HULETT'S SUGAR CORPORATION LTD., of Durban, Natal, South Africa. **1,329,332.** 17th May 1971; 5th September 1973.

The annular space 12 at the top of a conventional vacuum pan is connected by vapour tubing to an external condenser. The pan 10, however, has an internal condenser which forms a sector of the space 12 and is provided with a series of horizontal or sloping trays 18 along which passes cooling water admitted through pipe 16. The sector is bounded by vertical plates which end above the baffles 20 and a bottom plate 27 forms a floor to the condensing zone.



Vapour enters the gap between the vertical plates and the baffles and is liquefied by contact with the cooling surfaces of the trays; condensate runs down and passes into outlet 30, while incondensable gases are withdrawn through pipe 24.

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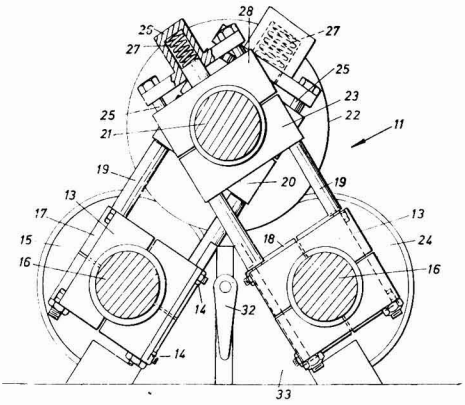
Animal fodder from cane. CANADIAN CANE EQUIPMENT LTD., of Montreal, Quebec, Canada. **1,329,766.** 19th April 1971; 12th September 1973.—The feed comprises cane pith containing substantially all its naturally-present juice (containing $>10\%$ by weight of sugars) and the fine inner fibres of the cane stalk, substantially free of outer rind fibres. For ruminants, additional nitrogenous protein substitute (urea) may be added, with chopped cane tops. For non-ruminants, a natural protein source (blood or fishmeal) may be added. In addition there may be added a mineral mix and *Lactobacillus* or *Acetobacter* micro-organisms.

* * *

Cane mill. F. MORALES V., of Mexico, D.F. **1,330,981.** 14th June 1971; 19th September 1973.

The ends of the roller shafts 16, 21 of the three-roller mill 11 are housed in bearings 13, 23, 20 which are carried by spacer shafts 19, so that movement of the bearings along the shafts varies the clearance between the rollers 15, 22, 24. The spacer shafts extend beyond the upper bearings, and the extensions 25 engage with pressure heads which may have hydraulic or mechanical means (springs as shown) acting on pistons directing the upper bearings down the shafts 19 towards the lower bearings and so reducing the clearance between rollers.



The lower bearings 13 are held by bolts 14 to a triangular body 33 at the side of the mill, and the upper bearings are able to move to provide free floating of the top roller to accommodate the passage of cane through the mill.

Copies of Specifications of United Kingdom Patents can be obtained on application to The Patent Office, Sale Branch, Block C, Station Square House, St. Mary Cray, Orpington, Kent, England (price 25p each). United States patent specifications are obtainable from: The Commissioner of Patents, Washington, D.C. 20231 USA (price 50 cents each).

Production of a polysaccharide. TATE & LYLE LTD., of London EC3, England. **1,331,771.** 7th April 1970; 26th September 1973.—An alginic acid-like polysaccharide (a partially acetylated variable block copolymer of 1-4 linked D-mannuronic acid and L-guluronic acid), suitable as a thickener for the food or paper industries, is prepared by cultivation of *Azotobacter vinelandii* under aerobic conditions (with bubbling of oxygen or air equivalent to 5–50 millimoles/litre of medium per hour) in an aqueous nutrient medium containing a carbon source comprising at least one monosaccharide and/or disaccharide (dextrose, sucrose, molasses, invert sugar or an intermediate product from sugar processing) (in a concentration equivalent to 0·2–3 g sucrose per 100 ml water) and containing as essential ingredients sources of Mo, Fe, PO_4 [at a concentration of 0·015–1·4 mM (0·2–0·7 mM)], Mg, K, Na, Ca and SO_4 (including a Ca salt equivalent to 0·02–0·2 g $CaCl_2$ per litre of medium) (and a fixed N source). The pH is maintained between 6·5 and 8·5 for at least the first half of the fermentation period and between 4·6 and 8·5 for the remainder [between 6·5 and 8·5 (7·0–7·5) throughout].

* * *

Beet harvesters. (A) H. VISSERS N.V., of Nieuw-Vennep, Holland. **1,331,972.** 30th November 1970; 26th September 1973. (B) S. A. HERRIAU, of Cambrai (Nord), France. **1,331,991.** 1st September 1970; 26th September 1973.

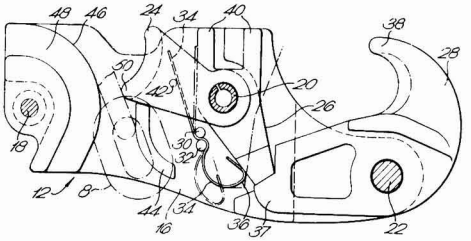
* * *

Sucrose esters. DAI-ICHI KOGYO SEIYAKU CO. LTD., of Kyoto, Japan. **1,332,190.** 21st October 1970; 3rd October 1973.—A (C_8–C_{22}) fatty acid [C⩾$_6$ (Me, Et or Pr)] ester (of butanol, ethylene glycol, propylene glycol, butylene glycol, glycerol, sorbitol or pentaerythritol) and (0·1–10% on sucrose of) a transesterification catalyst (a hydroxide, carbonate, bicarbonate, methoxide, ethoxide or propoxide of K, Na or Li) are added to an aqueous solution of sucrose (in a proportion of 1/19 to 4 parts sucrose per part of ester by weight) and (5–40% on weight of sucrose plus ester of) a (C_{12}–C_{22}) fatty acid (K, Na or Ca) soap in (100–200% by weight of) water under such (changing) conditions of (sub-atmospheric) pressure (60–0 mm Hg) and elevated temperature (110–175°C) that a substantially completely dehydrated melt is obtained without any substantial loss of the fatty acid ester through hydrolysis, (further ester added) and the melt maintained at 110–175°C to permit alcoholysis or transesterification of the fatty acid ester by the sucrose.

* * *

Cane sling hook. PARSONS CHAIN CO. LTD., of Stourport-on-Severn, Worcs., England. **1,334,192.** 1st December 1971; 17th October 1973.

Bundles of cane are held by slings in the form of lengths of chain, the ends of which have loops which are held by hooks 28 while the remainder form nooses passing through the body of the hook before being attached to a lifting beam. The hook 28 pivots about pin 22 which joins the side plates 16, as do rivet 18, fixed pins 30, 32 and pivot pin 20. The last supports a pawl 24 and a latch 26, the latter engaging with the nose 37 of the hook 28 and being held by leaf spring 34. The other end of the leaf spring engages with a pin 42 carried by pawl 24, so directing the nose 50 of the pawl to engage with and lock the links of



chain 8 as they are guided through the hook housing by projection 44 and surfaces 46, 48. As the chain noose is tightened around a cane bundle the chain is pulled through the gap, the pawl moving against the spring pressure. Movement in the opposite direction is prevented by its abutting the end of projection 44 so that the bundle remains tightly held. When it is desired to loosen the bundle a lever is inserted in the fork 40 of the latch and the latter pivoted against spring pressure so that the hook 28 can pivot, releasing the loop.

* * *

Cane sugar extraction. THE FRENCH OIL MILL MACHINERY CO., of Piqua, Ohio, USA. **1,334,367.** 17th December 1970; 17th October 1973.—See U.S. Patent 3,661,082[1].

* * *

Method of increasing the sugar recoverable from sugar cane. VELSICOL CHEMICAL CORP., of Chicago, Ill., USA. **1,334,435.** 26th May 1971; 17th October 1973. The sucrose content of cane is increased by contacting it with at least 0·25 lb.acre^{-1} [at least 0·5 lb.acre^{-1} (0·5–1·5 lb.acre^{-1})] of a [C_1–C_{10} (methyl, decyl)] alkyl ester of 2-methoxy-3,6-dichlorobenzoic acid [during the period 2–4 weeks before harvest, and in a liquid (emulsion) formulation].

* * *

Batch-type sugar centrifugal. FIVES LILLE-CAIL, of Paris 8e, France. **1,334,612.** 19th April 1971; 24th October 1973.

The basket 10 is carried by shaft 12 and mounted by means of a spherical ball joint 13 the centre of which is approximately at the centre of gravity of the basket and also on the axis of shaft 12. It is coupled to the shaft by the flexible coupling which comprises plates 16, 17 held by the basket and shaft, respectively, and connected by resilient studs or ring 15.

[1] *I.S.J.*, 1973, **75**, 258.

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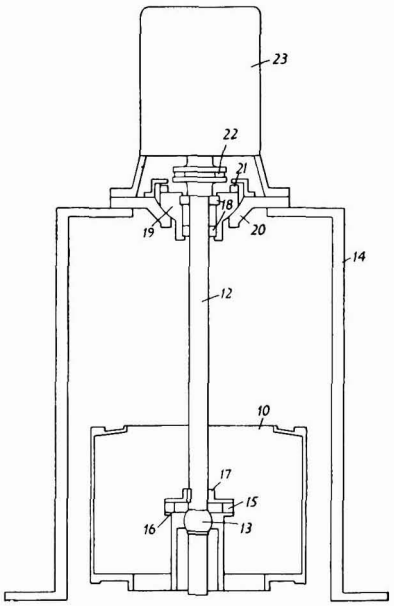
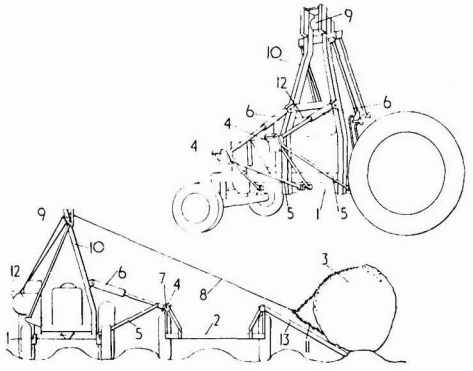


At the upper end of the shaft it has radial bearings to allow rotation within the support bearing 19 which is in the form of a ball joint able to move within the cup 20 but with limits imposed by resilient ring or studs 21. The shaft is driven and braked by motor 23 which is connected to the shaft by flexible joint 22 the centre of which coincides with the centre of ball joint 19. The arrangement permits rocking motion of the basket and shaft caused by imbalance, the resilient parts acting in opposition to this motion.

* * *

Cane loading. TATE & LYLE LTD., of London EC3, England. **1,335,734.** 25th January 1971; 31st October 1973.

The loader 1 is positioned next to a trailer 2 in the field on the side opposite the cane bundle 3. Buffer arms 4 are pivoted at their base, connected with swinging links 5 and, when extended by the hydraulic rams 6, engage with the rail 7 on the side of the trailer.



The cable 8 is paid out over the pulley 9 at the top of the A-frame 10 and attached to the chains 11 binding the cane bundle. The winch 12 is then used to haul the bundle up the ramps 13 into the trailer. The cable may then be disconnected and winched back, the buffer arms retracted and the loader driven to the next trailer.

* * *

Detergent compositions. DAI-ICHI KOGYO SEIYAKU CO. LTD., of Kyoto, Japan. **1,335,959.** 12th September 1972; 31st October 1973.—The detergent comprises an aqueous solution [of pH 5·5–7·5 (6–7)] containing a mixture of [5–50 (10–35) (3–25) (5–20) parts of] at least one sucrose ester of a saturated or unsaturated C_6–C_{22} (at least 70% of C_{12}) fatty acid [having 1·0–1·8 (1·23–1·57) fatty acid molecules per molecule of sucrose in the ester], [15–80 (30–70) (3–45) (5–30) parts of] an organic acid component which may be malic and/or tartaric acid and/or alkaline (K or Na) salts of these (Na tartrate, Na malate), (and [5–65 (10–42) parts of] an amino-acid component which may be glutamic acid and/or glycine and/or an alkaline salt of these (Na glutamate)) [and (5–30% on solution weight of) a saccharide component (sorbitol or sucrose)].

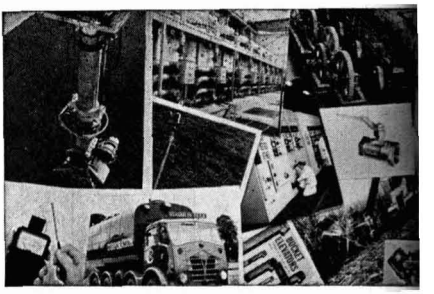
* * *

Improvements in flocculating aqueous suspensions. HENKEL & CIE. GMBH of Düsseldorf, Germany. **1,336,041.** 28th April 1971; 7th November 1973. Clarification of sugar juices is improved by use of a flocculant prepared by reacting a (alkoxylated) polyacrylamide {containing [5–100% (10–80%) on the polyacrylamide residue of] C_3 or C_4 alkoxy groups} with an epoxy compound, i.e. an unsubstituted alkylene oxide {or by reacting polyacrylamide with 0·2–20 (0·5–2·5) mol.% of an amine or quaternary ammonium compound having an epoxide group [*1-(trialkylammonium-2,3-epoxypropane (having* C_1–C_8 *alkyl groups)*]}.

* * *

Sugar nucleation and its preparation. BATTELLE DEVELOPMENT CORP., of Columbus, Ohio, USA. **1,342,126.** 26th July 1971; 28th December 1973. A low-M.W. polar organic compound which may be an aliphatic ether, ester, ketone, aldehyde, alkanol or a mixture of these [an alkanol of 1–8 (1–6) C atoms *(ethanol)*] is added to a sucrose feed syrup containing 60–80% sucrose in water, in sufficient quantity to give an organic compound:water ratio of between 0·6:1 and 3:1 (1:1–2·5:1) (1·2:1–1·6:1) and mixed to give a suspension of (at least 75%) single crystals having a population density of at least 10,000 particles per cm^3 per micron, and a population weighted mean nucleus size of between 10 and 30μ. This suspension is used as seed for growing of sugar crystals from syrup.

Trade notices



Statements published under this heading are based on information supplied by the firm or individual concerned. Literature can generally be obtained on request from the address given.

PUBLICATIONS RECEIVED

CHAINS FOR CONVEYING AND POWER TRANSMISSION. Ewart Chainbelt Co. Ltd., Colombo St., Derby, DE3 8LX England.

Catalogue No. 540 has been updated, its 56 pages (in English, French, German and Spanish) opening with a section on metallurgical data, covering both steel and cast malleable iron chains, which is followed by a quick-reference summary and index of chains available; individual categories are covered in greater detail: steel driving chains, elevator roller chains, conveyor roller chains, SS class bushed, combination, pintle, Gray pin, Ley bushed, drag link, De Brouwer, intermediate carrier, malleable roller, crate conveyor and bottle slat conveyor chains, together with appropriate attachment link data. Information on chain service factors and speed correction factors is included to simplify selection based on allowable chain pull, and the catalogue ends with a numerical index.

* * *

WALLER EQUIPMENT. George Waller & Son Ltd., Derby Rd., Chesterfield, Derbyshire, S40 2EB England.

Leaflets and brochures available from Waller cover a number of Roots-type compressors, blowers and exhausters, a new 2-stage vacuum pump unit comprising a standard water-ring pump supercharged by a Roots-type compressor, the Waller non-return valve and interlocking double-gate valves.

* * *

JEFFREY PRODUCTS FOR THE SUGAR INDUSTRY. Jeffrey Galion Americas Corp., North 4th St., Columbus, Ohio, 43216 USA.

Among literature available from Jeffrey are a 75-page brochure, PT-182, giving details of their helical reducers and gearmotors, PT-212 on shaft-mounted and screw conveyor drives (36 pp), PT-213 on Whitney precision roller chain (113 pp), PT-214 covering parallel-shaft and spiral bevel reducers (178 pp), PT-216 giving information on the "Sani-Gard" worm gearmotor, PT-220 on the Whitney 81X conveyor chain, PT-221 on Types WS and WSD welded steel chains, and PT-224 covering Jeffrey A.C. motors of special design.

* * *

DDS PAN BOILING AUTOMATIC CONTROL. A/S De danske Sukkerfabrikker, 5 Langebrogade, DK-1001 Copenhagen K, Denmark.

The DDS automatic pan boiling system is available in three models. Model I, especially developed for the cane sugar industry, is intended for final boiling of *A*- or *B*-massecuite after the main syrup intake; Model II is for *A*-, *B*- or *C*-massecuite and controls the boiling process from the start to the cutting of the strike (with the stage "waiting for discharge with water and lower steam pressure" omitted); and Model III is for control of the complete boiling process for all three massecuites. Full details are given in a brochure which is available from DDS.

CLAAS-LIBERTADORA 1400 CANE HARVESTER. Gebr. Claas Maschinenfabrik GmbH, 4834 Harsewinkel, Postf. 140, Germany.

The "Libertadora 1400" harvester can handle both green and burnt cane and has a number of advantages which are clearly illustrated in a new coloured brochure.

* * *

ABR EQUIPMENT FOR THE SUGAR INDUSTRY. ABR Engineering, rue du Trône 4, 1050 Brussels, Belgium.

ABR experience in the design and supply of equipment for both the beet and the cane sugar industries is described in a handsome brochure, while details are given, in a separate brochure, of the ABR white sugar silo as constructed at Wanze sugar factory, Belgium.

* * *

TATE & LYLE PRODUCTS FOR THE SUGAR INDUSTRY. Tate & Lyle Enterprises Ltd., Cosmos House, 1 Bromley Common, Bromley, Kent, BR2 9NA England.

Bulletins available from Tate & Lyle give information on "Talofloc" decolorizing agent, "Talosep" juice flocculating agent, "Taloflote" flotation aid, "Talozyme BA" starch-removing enzyme, "Taluron D" substituted urea herbicide for use in cane, and "Talocide Q" mill sanitation agent. Also available from Tate & Lyle are brochures describing the "Talofloc process for sugar refining, the "Talo" flotation system for sweetening-off muds, and the "Talameter" sugar colorimeter.

* * *

DIATOMITE FILTER AIDS. Eagle-Picher Industries Inc., 900 American Building, Cincinnati, Ohio, 45202 USA.

A 13-page brochure carries information on production, properties and uses of "Celatom" diatomite filter aid (kieselguhr) which is widely used in the sugar industry.

* * *

CONTROL VALVES. Introl Ltd., Pellon Estate, Halifax, Yorks., England.

A 12-page leaflet gives comprehensive technical data on the new Introl Series 60A "Aerovane" control valves which operate on the well-proven butterfly principle and can handle flow in either direction. Reversal of the valve action in the field is possible without additional parts or special tools.

* * *

MEGATOR PUMPS. Megator Pumps & Compressors Ltd., 87A Newington Causeway, London SE1 6EQ, England.

Literature available from Megator describes their sliding-shoe pumps which can handle liquids of any viscosity and work by means of three or more rotary eccentric discs each of which reciprocates horizontally in a plastic displacement chamber or shoe, like a piston in a cylinder, while at the same time making the shoe reciprocate vertically, so that the ports in the base of the shoe register alternately with the suction and discharge ports in the stainless steel port plate. Other leaflets describe Megator-Albin Types RB, RBD and RK internal-gear pumps, Megator condensate return units and booster and fire sets.

* * *

EVAPORATORS FOR THE CHEMICAL PROCESS INDUSTRIES. The A.P.V. Co. Ltd., P.O. Box 4, Crawley, Sussex, RH10 2QB England.

A new 11-page brochure gives information on the various types of evaporator available from APV, including the forced-circulation and climbing-film (Kestner) types, the falling-film evaporator, the APV-Rosco type recompression evaporator, plate evaporator, "Paravap" evaporator and pilot-scale models of the Kestner types, the falling-film type and the APV "Junior" plate evaporator for research or limited production pruposes.

USSR sugar imports and exports[1]

	1971	1972	1973
	metric tons, raw value		
IMPORTS			
Argentina	0	0	15,877
Australia	0	119,564	75,933
Brazil	0	299,755	458,451
Colombia	0	10,000	60,611
Costa Rica	0	0	15,600
Cuba	1,535,709	1,101,379	1,603,326
Czechoslovakia	0	21,740	21,740
Dominican Republic	0	23,152	99,962
Ecuador	0	10,617	0
France	0	53,738	0
Germany, East	0	81,525	0
Guatemala	0	0	27,461
Holland	0	10,870	0
Mauritius	0	25,187	12,259
Nicaragua	0	0	10,297
Peru	0	0	96,834
Poland	0	108,700	108,698
Salvador	0	24,196	23,706
Venezuela	0	34,019	0
	1,535,709	1,924,442	2,630,755
EXPORTS			
Afghanistan	44,677	18,446	10,999
Algeria	116,844	0	0
Bulgaria	94,297	0	0
Cyprus	6,521	0	0
Egypt	9,705	0	0
Finland	136,472	188	0
Germany, East	75,239	0	0
Ghana	16,638	0	0
Guinea	1,175	0	0
Hungary	76,377	0	0
Indonesia	82,322	0	0
Iran	66,377	5,870	0
Iraq	168,262	0	0
Italy	545	0	0
Jordan	48,275	0	0
Korea, North	12,825	5,452	0
Kuwait	11,271	0	0
Lebanon	30,265	0	0
Mali	6,691	0	0
Malta	165	0	0
Mongolia	20,074	23,484	24,462
Nigeria	38,007	0	0
Saudi Arabia	10,632	0	0
Sierra Leone	4,414	0	0
Somalia	6,522	0	0
South Yemen Republic	13,265	0	0
Sri Lanka	45,815	0	0
Sudan	71,536	0	0
Sweden	30,593	r	0
Togo	1,332	0	0
UK	86,078	0	0
Vietnam, North	16,245	10,747	10,875
Yemen	41,475	0	0
Other countries	10,617	0	0
	1,401,548	64,187	46,336

Beet payment in Japan[2].—The price to be paid for beet in Japan has been raised by 29·8% to a record 11,110 yen per metric ton, according to the Ministry of Agriculture and Forestry. The price has been raised in line with the Government's policy of encouraging domestic production of agricultural products, including sugar. The Japanese sugar beet crop in 1973 totalled 2,948,000 tons.

Brevities

New Pakistan sugar and bagasse paper factories[3].—Construction has started of a factory at Khazan in Peshawar, which will process 3000–3500 t.c.d. and 2000–2500 tons of beet per day. The West Pakistan Industrial Development Corporation, with Chinese help, has erected a sugar factory at Naudero in the Larkana district of Sind Province. The project is understood to involve some 100 million rupees, and the factory has a designed annual capacity of 15,000–18,000 tons of white sugar. It is also intended to set up a new factory in the district of Dadu, which is expected to start operations in two years, and another at Thatt in Sind Province. A paper factory at Charsadda is to be erected, and will use bagasse as raw material.

* * *

Canada beet sugar crop, 1973/74[4].—The area harvested in the 1973/74 campaign totalled 68,640 acres, compared with 77,587 acres in 1972/73. Sugar production was also reduced, from 113,037 long tons in the previous crop, to 105,674 tons in 1973/74. The estimated beet area for the 1974/75 campaign is 78,000 acres.

* * *

New sugar factories for Rumania[5].—Two new sugar factories are to be built in Rumania, the foundations for both having been laid at the end of March. One factory, to be built near Urziceni, will have a slicing capacity of 4000 tons of beets per day; the date for starting operations has not been mentioned, however. The second factory is to be built at Tandarei.

* * *

Réunion sugar production, 1973[6].—Sugar production in Réunion totalled 239,701 metric tons, produced from 2,166,195 tons of cane at a yield of 11·14%. This compares with 232,184 tons of sugar produced at a yield of 10·43% in 1972 from a cane crop of 2,174,875 tons.

* * *

New Zealand sugar imports, 1973[7].—Imports of sugar into New Zealand in 1973 totalled 160,103 metric tons, raw value, of which 109,242 tons came from Australia, 22,949 from Dominican Republic, 15,049 tons from Fiji and 12,949 tons from Cuba.

* * *

Austrian sugar campaign, 1973/74[8].—The seven sugar factories processed a total of 2,222,063 metric tons of beet in the 1973/74 campaign, grown on 51,300 hectares. The average sugar content was 17·27% and the average recovery 15·04%, giving a white sugar outturn of 333,986 tons during the campaign, which lasted 73 days on average.

* * *

Argentina sugar production, 1973[9].—Sugar production in Argentina during the 1973 season amounted to 1,541,837 metric tons, of which 1,105,639 tons was white sugar and 436,198 tons raw sugar. This compares with a production of 1,209,849 tons (1,072,436 tons of white sugar and 137,413 tons of raw sugar) produced in the 1972 season. The increase of some 332,000 tons represents a rise of 27·44% above 1972 production.

* * *

Cane sugar factory for Saudi Arabia[10].—A cane sugar factory is to be built in Jizan, to have a production capacity of 100,000 tons of sugar per year.

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[1] *I.S.O. Stat. Bull.*, 1974, **33**, (6), 108–109.
[2] *Public Ledger*, 13th April 1974.
[3] F. O. Licht, *International Sugar Rpt.*, 1974, **106**, (9), 9; *Zeitsch. Zuckerind.*, 1974, **99**, 209.
[4] C. Czarnikow Ltd., *Sugar Review*, 1974, (1174), 64.
[5] F. O. Licht, *International Sugar Rpt.*, 1974, **106**, (10), 6.
[6] *Zeitsch. Zuckerind.*, 1974, **99**, 208.
[7] F. O. Licht, *International Sugar Rpt.*, 1974, **106**, (10), x.
[8] *Zeitsch. Zuckerind.*, 1974, **99**, 208.
[9] F. O. Licht, *International Sugar Rpt.*, 1974, **106**, (10), 8, xi.
[10] *Zeitsch. Zuckerind.*, 1974, **99**, 210.

Brevities

US sugar factory closures[1].—Cane milling has ceased at Poplar Grove sugar factory in Louisiana. The Vida mill closed in 1973 and its machinery has been sold for shipment to the Philippines.

* * *

West Indies sugar sales to China[2].—Jamaica is to sell large quantities of sugar to China over the next five years at a price as yet to be determined. The sugar is to be sold on a basis that Jamaica must be entitled to recover the cost of production and the guaranteed price to farmers and producers. Jamaica intends to ship 10,000 tons of sugar to China this year, 40,000 tons in 1975 and 50,000 tons in 1976, 1977 and 1978. Guyana is also to sell 30,000 tons of sugar to China in 1974 at a price "quite a few times higher" than that paid by the UK and USA, as the result of a trade agreement.

* * *

Puerto Rico sugar production[3].—The 1973/74 season in Puerto Rico came to a close with a final production of 287,269 short tons, raw value, which compares with 252,223 tons produced in 1972/73. Despite the recovery it is expected that the drought will reduce prospects for the 1974/75 season.

* * *

BMA sugar factory in Chile.—Early in June 1974 the white sugar factory at Curico, Chile, was successfully commissioned by Braunschweigische Maschinenbauanstalt and handed over to the Industria Azucarera Nacional S.A. The guaranteed capacity of 3000 tons of beet per day was exceeded after only seven days, indicating the success of the plant and its design. Between the 10th and 12th June the average slice was 3109 tons per day and sugar losses 0·14% on beet while steam consumption averaged 32% on beet.

* * *

Beet payment in Spain[4].—The Spanish Government has fixed a price for 1974 beet which is 345 pesetas/ton higher than the 1973 figure of 1365·92 pesetas/ton at a sugar content of 16%. At the same time the price of sugar ex factory has been raised from 15·10 pesetas/kg in 1973 to 18·60 pesetas/kg.

* * *

Polish beet area expansion plans.—According to "Zycie Warszawy", the sugar beet area in Poland is to be extended by 10% by 1980. However, the paper also states that 12 new sugar factories would have to be built (rather than the 2 already planned) in order to attain a sufficient slicing capacity for the whole country. Moreover, improvements in mechanized sowing and harvesting are considered necessary.

* * *

New sugar factory for El Salvador[5].—The Instituto Salvadoreno de Fomento Industrial has called for bids for construction of Ingenio Jiboa, a factory to have a capacity of 3000 t.c.d. with the possibility of extension to 5500 t.c.d. It is to include a refinery having a capacity of 125 tons of sugar per day, capable of expansion to 250 tons per day. The factory will operate for 140 days per year and its cost, estimated earlier at $13–$15 million, will now be about $19–$20 million. The first harvest will be in 1976/77.

* * *

Dutch participation in Indonesia.—Stork-Werkspoor Sugar B.V. have entered into partnership with three Indonesian firms for the erection and operation of a factory for the production of sugar machinery. Under the terms of the partnership, SWS has invested capital in the new firm, P. T. Boma-Stork, and has concluded know-how and management agreements. The result will be a reduction in machinery imports, a saving in foreign currency, promotion of local manufacture and development of skills in local labour.

South Africa sugar exports[6]

	1973	1972	1971
	(metric tons, raw value)		
Canada	281,461	272,384	262,293
Finland	36,412	73,198	0
Hong Kong	1,848	6,033	15,356
Israel	35,871	55,435	10,870
Japan	467,272	568,625	372,372
Seychelles	2,012	2,210	2,022
Sri Lanka	0	13,077	0
UK	0	19,363	0
USA	89,550	28,576	81,949
Vietnam, South	0	0	10,604
Other countries	282	7,040	10,532
	914,708	1,045,941	765,998

Jamaica sugar situation[7].—Latest estimates of sugar production from the 1974 crop in Jamaica total 357,000 tons, which is a downward revision of 800 tons on earlier estimates. Already one shipment of 5,904 tons of refined sugar has been made from Cuba to help alleviate the shortage of sugar on the local market.

* * *

Sugar industry expansion in Venezuela[8].—In order to eliminate the shortage of sugar facing Venezuela, the Corporación Venezolana de Fomento is studying a plan for enlarging the country's sugar factories. The programme includes investment of 300 million bolivars ($7,000,000), most of which is to be spent in bringing 25,000 hectares of sugar cane into cultivation, and the remainder for increasing the capacity of certain factories.

* * *

Venezuela sugar imports possibility.—It is reported[9] that there is a possibility that Venezuela will import 40,000 tons of sugar if this year's sugar production is very low, although at present it seems that production will be sufficient to cover domestic requirements. However, last year sugar had to be imported from Brazil and the Dominican Republic, and during the period September 1973–February 1974 only 244,800 tons were produced compared with 263,700 tons in the corresponding period of the previous season.

* * *

South African sugar production 1973/74.—The South African Sugar Association has announced a final sugar output for 1973/74 of 1,731,575 tons, compared with 1,914,601 tons in 1972/73. Exports in 1973/74 amounted to 750,087 tons, while in 1972/73 they totalled 1,002,839 tons.

* * *

Guyana sugar crop, 1973.—A total of 3,270,179 long tons of cane were crushed by the eleven factories during the 1973 crops in Guyana, and yieldsd 265,704 tons of sugar of average pol 97·56. In the 1972 crops a total of 3,595,777 tons were crushed to give 314,600 tons of sugar of 97·96 average pol. Actual and reduced extraction % cane were both slightly lower but juice purity was the lowest for over ten years so that pol recovery was low and molasses production high by comparison with previous years. Time lost out of cane was even higher than in 1972, at 15·75% of gross grinding time, but time lost because of strikes was fortunately less although still reaching 2·66%.

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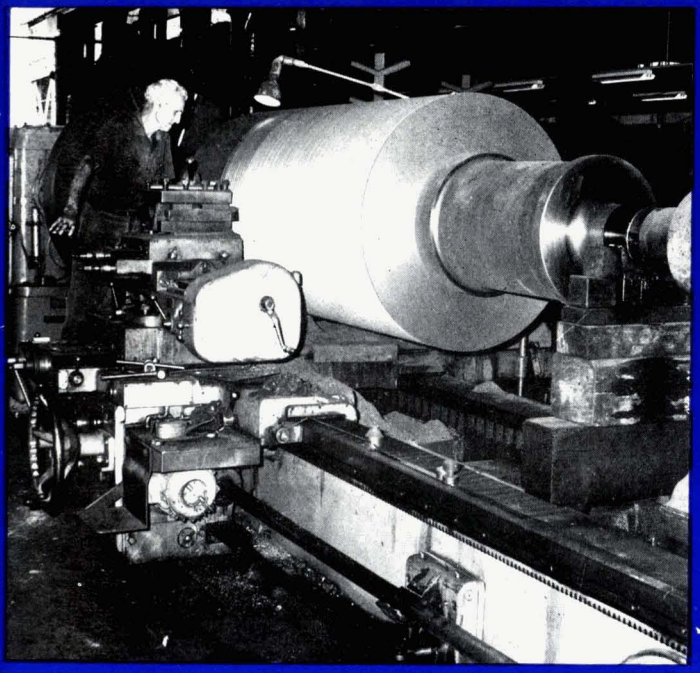
[1] *Sugar y Azúcar*, 1974, **69**, (6), 72.
[2] *W. Indies Chron.*, 1974, **89**, 213, 219.
[3] C. Czarnikow Ltd., *Sugar Review*, 1974, (1189), 128.
[4] *Zeitsch. Zuckerind.*, 1974, **99**, 275.
[5] *Amerop Notocias*, 1974, (6), 6.
[6] *I.S.O. Stat. Bull.*, 1974, **33**, (3), 94.
[7] *Barclays International Review*, April 1974, 43.
[8] *Amerop Noticias*, 1974, (6), 7.
[9] F. O. Licht, *International Sugar Rpt.*, 1974, **106**, (12), 8.



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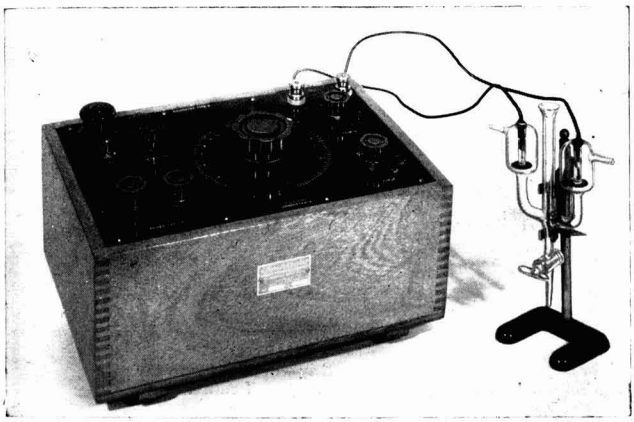

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